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IN THIS ISSUE

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ABOUT THE COVER: *Detail from* The Western Shore of Lake Michigan and Environs, *by Jake Coolidge. See Visual Fields, starting on page 25, for more information and images.*

LETTER FROM THE EDITOR

Six years ago, I took the reigns of editorship of *Cartographic Perspectives* from Fritz Kessler's very capable hands. We were aware *CP* had reached a crossroads, and that taking a new path would involve traversing uncharted territory. Since then, I have taken pride in the great strides which *CP* has made, including initiating an online submission and review system, providing a web site for immediate access to published materials, and opening up access to all current and past articles.

Fritz's sagest words to me, however, were not about the next steps in the journey, but related to the people who would help me along the way. He impressed upon me the opportunity that the *CP* editorship offered to reach out to cartographers known for their research, critique, artistry, and leadership. This was indeed a golden chance, and the input and contributions of many colleagues have enhanced our journal in innumerable ways.

This very section of the journal serves as a wonderful means for some of our colleagues to contribute. The typical title of this section, "Letter from the Editor" has been revised in other issues to "Letter from the Guest Editors(s)." Over the last six years we have had three special issues, with prestigious Guest Editors Aileen Buckley and Bernhard Jenny (Aesthetics), Anthony Robinson and Robert Roth (Cognition, Behavior, and Representation), and David Fairbairn (Cartographic Education). Their efforts have done much to enhance our journal by focusing on themes central to cartographic research and practice, while simultaneously lightening my load.

This same section has also been the venue for our annual "Letter from the President." I appreciate the contributions from past presidents Tanya Buckingham, Erik Steiner, Neil Allen, Nathaniel Vaughn Kelso, and Alex Tait. Their views reflect the strong leadership and vision of all of the NACIS officers I've worked with, past and present: Martha Bostwick, , Lou Cross, Daniel Huffman, Jenny Marie Johnson, Eliana Macdonald, Susan Peschel, and Robert Roth. They, along with the dynamic NACIS Board of Directors, have always been forward thinking.

The past president missing from the list above is, of course, Amy Griffin, who went above and beyond this last year by agreeing to serve as Co-Editor of *CP* while also continuing in her role as the President of NACIS. I greatly enjoyed sharing journalistic responsibilities with Amy, and know *CP* has a very bright and successful future in her extremely capable hands.

Together, Amy and I have rounded up a great collection of articles for *CP* 82. In the peer-reviewed section, Salla Multimäki, Andreas Hall, and Paula Ahonen-Rainio of Aalto University in Helsinki propose a novel approach to help users better comprehend animations of datasets comprised of a large number of points by use of temporal classes for phenomena showing increasing, decreasing, and steady intensities.

The cartographic collection featured in this issue is the Lionel Pincus and Princess Firyal Map Division at the New York Public Library. Kate Cordes walks us through this collection, from early maps in Joan Blaeu's *Atlas Maior* to recent digital initiatives like the NYC Space/Time Directory. This is followed by an article on cartographic education by Alison Feeney, where she makes a case for the importance of peer-evaluations in helping students to learn cartographic design principles.

If you enjoyed the Tangible Map Exhibit at NACIS 2015 in Minneapolis as much as I did, you will be delighted by our Visual Fields piece. Three of its organizers and contributors—Matt Dooley, Jake Coolidge, and Caroline Rose—discuss the maps exhibited by several artists and cartographers. Thanks to stunning photography by Dylan Moriarty, Charles Rader, and Matt Dooley, you are sure to feel like you can reach out and touch these maps all over again!

The works of three reviewers round out *CP* 72. The first is Mark Denil's review of *Essentials of Earth Imaging* for GIS by Lawrence Fox III and published by Esri Press. The second work is Russell Kirby's review of two books in the series *Mapping the Nation*, also by Esri Press. The last review is Karen Trifonoff's review of *Stitching the World* by longtime NACIS member Judith Tyner. Be sure to read the review, or better yet buy the book, if you are interested in learning more about embroidered maps and silken globes!

As the sun sets on my time as Co-Editor, I'd like to take one more opportunity to thank my current and former Assistant Editors Daniel Huffman, Laura McCormick, and Rob Roth, as well as all present and past Section Editors and members of the Editorial Board. Additionally, I'd like to express my gratitude to all those who have agreed to review manuscripts and drafts: I am in your debt. Finally, thanks to so many of our NACIS community and others beyond for your maps and writings. With contributions from across academia, industry, consulting and government, *CP* remains unique among cartographic journals, while remaining accessible to map lovers everywhere.

Patrick Kennelly
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Comparison of Temporally Classified and Unclassified Map Animations

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While animation is a natural and, under certain circumstances, effective way to present spatio-temporal information, it has its limitations. Studying animations of large point datasets can be cognitively very demanding. Aiming to help users to comprehend such data, this study presents a new concept of temporal classification. A phenomenon is classified into periods of increasing, decreasing, and steady intensity, and each is assigned different colours in an animation. This concept was tested with a group of experts in the field of the phenomenon. The results suggest that this kind of classified animation, together with a traditional animation presenting the same dataset, supports users in their analysis process and adds to the impression they get of the phenomenon. It also seems that the viewing order of the animations matters: the full potential of the tested method is reached by viewing the traditional version first and temporally classified version after that.

KEYWORDS: spatio-temporal pattern; temporal classification; map animation; visualization; concept testing

INTRODUCTION

While collecting big spatio-temporal datasets has become easier, effective tools and techniques are increasingly needed for understanding the phenomena represented by these data. Animation, as a time-bound method, is one of the conventional techniques for visualizing such data. However, animation has its limitations (Kriglstein, Pohl, and Smuc 2014; Aigner et al. 2011; Lobben 2008; Tversky, Morrison, and Betrancourt 2002). The capacity of an animation to support an analyst depends on several factors, including the task, the type of phenomenon, and the structure of the data in question. When there is continuity in the movement of the phenomenon being visualized, an animation is at its best (Harrower and Fabrikant 2008; Andrienko, Andrienko, and Gatalsky 2005). But a dataset containing a large number of point-type events makes for a demanding presentation, especially if it does not provide such clear continuity. Human perception is particularly sensitive to appearance and movement, but at the same time it is easily overloaded (Kluender et al. 2006). When the perception of the user is constantly loaded with newly-appearing points, subtle patterns in the animation can easily be missed.

In analytical and exploratory use, when the user's task is not strictly defined beforehand, a single view of the data seldom reveals all the relevant aspects of a phenomenon. Therefore, multiple views, each displaying the data in a different way are valuable. Shneiderman (1996) suggests several data visualizers: *overview first, zoom and filter, then details-on-demand*. Animation can work especially well for getting an overview of a phenomenon (Harrower & Fabrikant 2008). Then, when a more detailed examination is needed after the overview, different ways to handle the massive information load of an animation can follow: the user can, for example, zoom in on a smaller area or a shorter time period for detailed examination or filter a subset of data based on some attribute information.

While task-definition is an essential part of designing analysis software, it is not always possible in analytical and exploratory use, when the user is seeking "something,"—for example, behavioural patterns of any kind. Visual data analysis can effectively bring human knowledge and capabilities to the exploratory process (Compieta et al. 2007). While some noise reduction is usually performed as pre-processing of the data, it is important that nothing potentially important is left out of the dataset before the interesting pattern is found. This conflict between the need to reduce the information load on the user, and the necessity to see everything, inspired us to seek a method where the behaviour of the phenomenon is visualized in such a way that a certain viewpoint is emphasized but no data reduction is conducted. In this paper we present a novel data classification method for map animations and study whether and how this method adds capacity to the exploration of spatio-temporal data.

To study the usefulness of this kind of temporally classified animation in comparison to an unclassified animation, we carried out a user test to find out how a temporally classified animation affects the user's impression of the phenomenon compared to an unclassified animation, and whether the viewing order of the animations matters if the temporally classified animation is used together with the unclassified animation.

In the user test, the subjects studied a phenomenon using both a temporally classified animation (henceforth called classified animation) and an unclassified animation (henceforth called traditional animation). The subjects were experts in the field of the visualized phenomenon. In the test, we examined the extent and contents of the users' descriptions of the phenomenon, based on the animations, and their opinions and feedback of the animations. In the following sections, we first explain the concept of temporal classification in detail. Next, we introduce the data and animations used in the test and explain the test setting. After that we present and discuss the results of the user test, and finally, draw conclusions.

CONCEPT OF TEMPORAL CLASSIFICATION

In cartography, maps with a large number of objects are known to burden users' cognitive processes (Bunch & Lloyd 2006). Classification of the data, based on attribute values, is performed to reduce the number of mental chunks that the user must handle at one time, and therefore increase the amount of information that can be effectively perceived. Classification can be made for static as well as animated maps (Slocum et al. 2009). Colour is a powerful attribute that can guide our attention (Wolfe and Horowitz 2004), therefore it is reasonable to use it to help the user cope with the information flow caused by constantly appearing events.

In this study, we propose a novel method to group data based on changes in its intensity into three classes: periods of increasing, decreasing, and stable occurrence of events. Furthermore, the data are divided into on meaningful spatial regions and the classification is done separately for each region. Thus, the method takes both the spatial and temporal characteristics of the data into consideration, and we can visualize homogeneous groups of events. The area can be divided, for example, by parallel zones, by a grid, or by some central point with circular zones inside each other. The division method plays a great role in how the movement or dispersion of the phenomenon is seen, and it is related to the modifiable areal unit problem (MAUP) of spatial analysis (Openshaw 1984).

The temporal classification method is comparable to the method of imposing a structure on the animation by segmenting, suggested by Harrower (2007). Patterson et al. (2014) agree that mental chunks can exist either in space or in time. The segments formed by temporal classification, presented in an animation one after another, can be seen as the mental chunks of an animation, a concept required by Harrower and Fabrikant (2008). In addition to this chunking of the data flow, temporal classification also guides the user's attention to potentially important patterns in the behaviour of the phenomenon by visually increasing their perceptual salience (Fabrikant & Goldsberry 2005).

TEST DATA AND ANIMATIONS

The dataset was downloaded from the Global Biodiversity Information Facility (**gbif.org**). It included all observations that voluntary bird observers made of grey and black geese (genera *Anser* and *Branta*) inside Finland in the year 2011. The total number of observations in the dataset was 18,175 and temporal resolution was one day. Some characteristics of this dataset required special attention. First, the number of observations does not equal the number of geese. This is because observation means one birder has seen either a single goose or a flock of geese. Second, the dataset does not include all occurrences of geese in the area, only the intersection of the birders and geese. Third, it is probable that the large difference in human population density between southern and northern Finland causes a bias in the dataset, as more observations occur in the south. Fourth, the spring migration shows much more strongly in the dataset than autumn migration, probably partly because the birders are more active in springtime.

Two test animations were made based on this dataset: classified and traditional animations. The animations presented the same observations, and each was 60 seconds in length. Presenting a 365-day period with a 1-day time interval gave a change rate of 0.164 seconds. Events which appeared on the map stayed visible for a time window of 7 days (1.15 seconds).

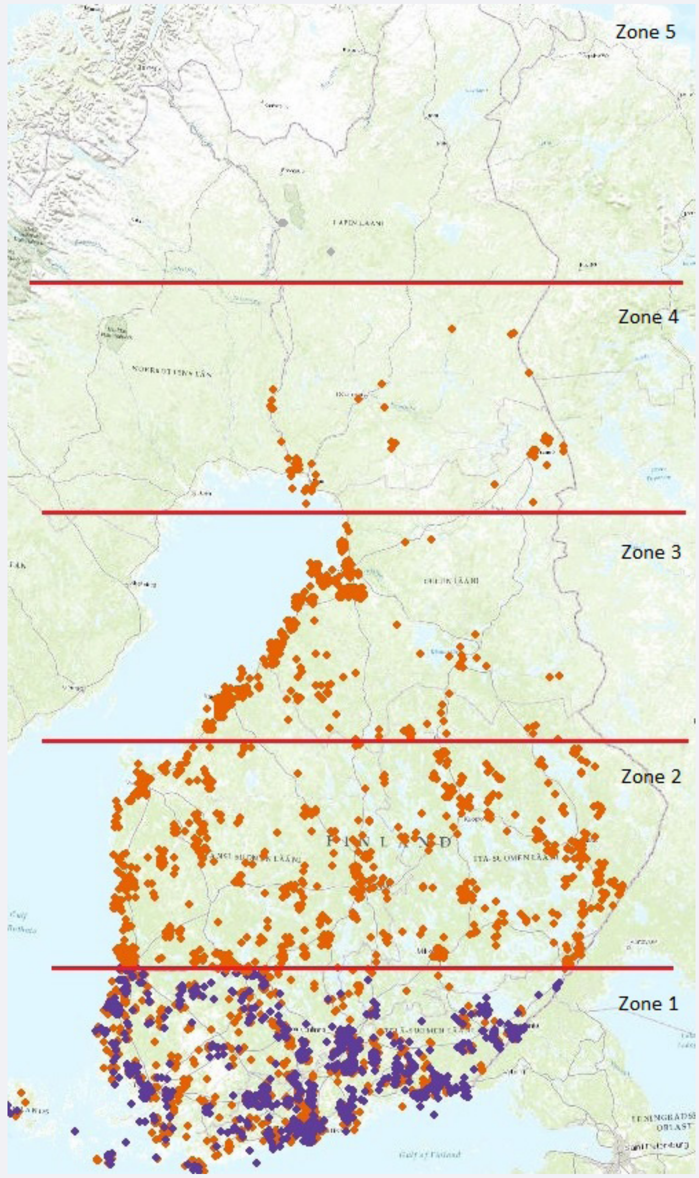

Figure 1. *The area is divided into five zones with equal width in a south-north direction. Basemap: Esri 2014.*

CLASSIFIED ANIMATION

To make a meaningful classification it is important to know your data; in our case this translates into knowing the behaviour of geese. Geese do not winter in Finland (except some individuals which stay on the southern shore), but great flocks migrate from southern Europe to nest in the north in the springtime. To reveal this south-north movement across Finland, the area was spatially divided into five latitudinal zones of 2° (Figure 1). The events from each zone were separately grouped into three classes according to changes in their intensity: increasing, decreasing, or steady. In this study, the classification was done manually from histograms of each zone's observations; changes shorter than two weeks were not taken into account. Figure 2 shows the histograms of the data of the two southernmost zones. The number of periods was not defined beforehand, but it proved to be seven in most of the zones: a steady period at the beginning of the year, strong increasing and decreasing periods caused by the spring migration, a steady summer period, weaker increasing and decreasing periods caused by the autumn migration, and again a steady winter period. In Figure 2, it can be seen how the peak of the spring migration happens a little earlier in the southernmost Zone 1 than in Zone 2. The difference in the total number of observations is also visible; the peak is twice as high in Zone 1 as in Zone 2.

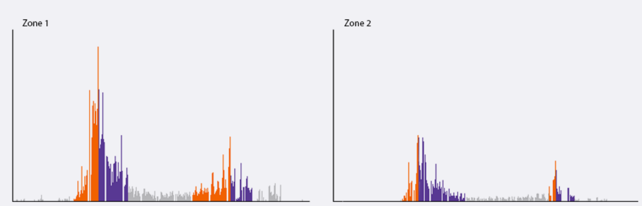

Figure 2. *Histograms showing observations of the two southernmost zones for a one-year period.*

In the classified animation, the points were coloured with a diverging colour scheme, where neutral grey represented the steady periods, and the increasing and decreasing periods were coloured with the complementary colours orange and purple, respectively. These colours are argued to be colour-blind-friendly (**colorbrewer.org**).

TRADITIONAL ANIMATION FOR COMPARISON

In the traditional animation, the colour of the events changed over time smoothly from yellow (January) via orange, red, and purple to blue (December). Figure 3 compares the classified animation to the traditional animation. The upper row shows three screen captures from the classified animation and the lower row screen captures of the corresponding moments in time from the traditional animation. In March, the phenomenon is steady (very few observations). In April, the growth of the phenomenon has spread to the north (except the northernmost parts), but at the same time it is already decreasing in the southern part of the country. In May, the phenomenon is decreasing throughout the whole country. In the traditional animation, the flow of time can be seen in the change of the colour of the dots. The change in the amount of events, however, can be seen only by the number of dots, and it is not very distinguishable.

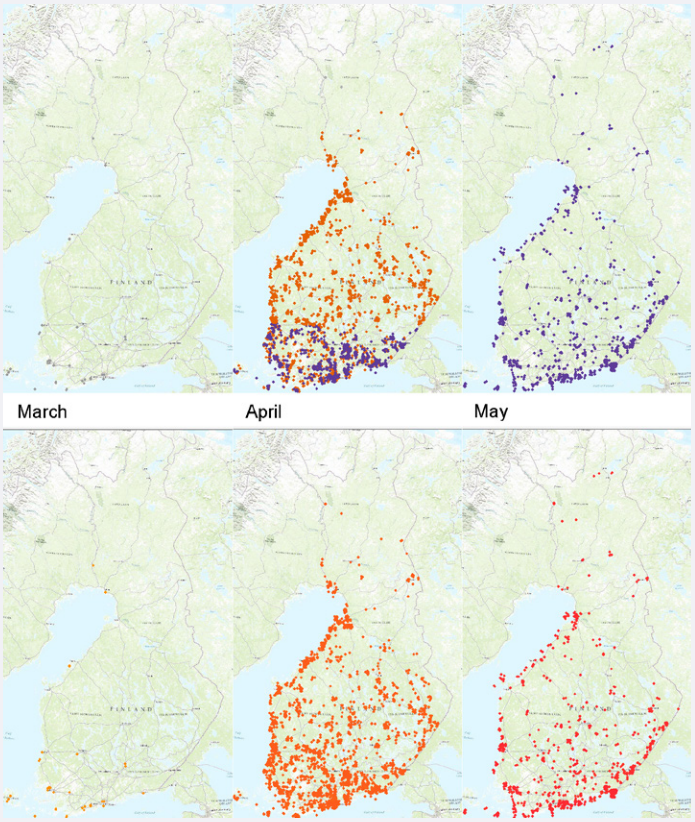

Figure 3. *Three screen captures from each animation. The figures in the upper row are from the classified animation, and the lower row shows the corresponding frame in the traditional animation. All captures are from the middle of the month. Basemap: Esri 2014.*

In the classified animation, in April, the orange and purple dots are mixing in the southern part of the country. This is because of the partial accumulation of the events in the test animation; the behaviour of the phenomenon has just changed to decreasing in this zone, and the last events of the previous increasing period are still visible.

USER TEST FOR COMPARING TEMPORALLY CLASSIFIED AND TRADITIONAL ANIMATION

The user test was carried out over the Internet. The test users were reached through the mailing list of BirdLife Finland, a society of bird observers, and they were all experienced birders. The 45 participants were randomly divided into two groups: Group 1 saw the classified animation first and the traditional animation second, Group 2 saw the animations in the reverse order. Otherwise, their test settings were identical.

The test consisted of two parts. At the beginning of the first part, the principles of the first animation were introduced briefly. Then the users were told to view the animation once or twice, after which, they were asked to describe the behaviour of the geese in their own words. Next, some claims about the behaviour of the geese were presented, and the users were asked to mark whether those claims were true or false. However, the results from the true-false claims were not used in this study because of an unforeseen bias: the "correct" answers were based on interpretations by the researchers using the same data and visualizations, and therefore could not been verified as being truth. The same process was repeated with the second animation: users were introduced to the upcoming animation, viewed it once or twice, described the behaviour, and answered true-false claims about the behaviour.

In the second part of the test, users were presented with a list of claims concerning the usability and pleasantness of the animations, and they were asked to mark their preferences between the animations. Finally, they had a chance to give their opinion of both animations in their own words, and were asked whether the animations gave them new information and what kind of phenomenon animations might suit best.

ANALYSIS AND RESULTS

Three analyses were conducted on the collected answers. First, the descriptions of the phenomenon were analysed with a verbal protocol method (McGuinness & Ross 2003). Next, the users' preferences between the animations were compared. Then, the free feedback on the animations was analysed by dividing all comments into four categories: positive feedback, negative feedback, mentions of new information, and mentions of potential use cases. Finally, the results of two user groups were compared against each other, as well as the results produced by the two animations.

To ensure comparability between the animations, some user responses were left out of the analyses. This was done if: 1) the subject did not fulfil the task of describing the phenomena at all, 2) the subject used only a few words, or 3) the subject wrote a description only for one of the animations. Answers from 11 users from each group were included in the analyses. In each group there were three females and eight males. The most common age group was 60–69 in Group 1 and 50–59 in Group 2. One of the users in Group 1 was colour-blind, but the answers of this user did not stand out from the others in the group and were therefore included in the analysis.

VERBAL DESCRIPTIONS OF THE PHENOMENON

Differences in the extent of the descriptions of the phenomenon between the two animations were apparent in the answers. A verbal protocol analysis was carried out to define these differences quantitatively. Verbal protocol analysis is a method in which all the verbal or textual feedback collected from the users is analysed in such a way that common patterns (ideas, tasks, descriptions, etc.) are recognized and calculated from the data (McGuinness & Ross 2003). Typically, these protocols cannot be defined beforehand, but they are recognized while going through the material. The encoding of the protocols was first performed separately by two researchers, after which those encodings were merged.

The statistical significance of the results from the verbal descriptions was tested with a T-test for unequal variances (independent when comparing animations or groups, and dependent when comparing the numbers inside the group).

From the data collected in the user test, different protocols were recognized from the texts: 1) appearance or disappearance, 2) number, increase, or decrease, 3) location, 4) direction, 5) route, 6) duration or speed of the movement, 7) relative time, 8) absolute time, and 9) animation time. Then these protocols were organized into three different categories: existence, movement, and time. The protocols and their categories are shown in Table 1, which also shows a few example words or expressions from each protocol, translated from Finnish.

	Protocol	Example Words or Expressions
Existence	appearance / disappearance	"migration starts" "first birds appear"
	number	"a few birds" "the number of birds is increasing"
	location	"in Northern Finland" "in the Southwest shore"
Movement	direction	"to north" "to inland"
	route	"following the shoreline" "along the main waterways"
	duration / speed	"rapidly moving flocks" "within a short time"
Time	relative	"first...then" "later" "at the beginning"
	absolute	"on March" "during the summer" "spring migration"
	animation	"around 17 seconds" "during seconds 12–35"

Table 1. *The protocols used in the verbal protocol analysis.*

The total number of words in these descriptions, excluding those sentences which only commented on the usability or visualisation of the animations, was also calculated. The calculated numbers of each protocol and word counts are shown in Table 2. All the results that are discussed more detailed below are statistically significant ($p < 0.05$).

The results of the protocol analysis reveal that the contents of the descriptions of the phenomenon varied between the user groups, and also between the animations, in the "existence" and "time" categories. The third category, "movement," gained the smallest number of mentions from both groups, and no statistically differences were not found. The cause for this might be that there was no actual movement in the animations, but rather the spreading behaviour of static events.

In the "existence" category, mentions of the "number" protocol more than doubled from 34 to 73 between the animations in Group 2 while the change between the animations in this protocol was not significant in Group 1. In the "location" protocol, Group 2, who saw the traditional animation first, made more than twice as many (144 vs. 64) mentions.

In the "time" category, the number of mentions of the "relative time" protocol was greater after the classified animation (65) than after the traditional animation (20) in both groups. Group 1 mentioned the relative time more often after the first animation than after the second, while in Group 2 the number of mentions of this protocol increased between the animations. On the other hand, the number of mentions of the "real-world time" protocol grew between the first and the second animation in both groups, but the total number of mentions in this protocol was bigger in Group 2 (104) than in Group 1 (74).

The word count reveals that Group 2 used more words after both animations, classified and traditional, when describing the phenomenon. The number of words after the first animation the users saw (classified animation with Group 1, traditional animation with Group 2) was almost the same between the groups (431/426), but after the second animation, the number of words decreased into 291 in Group 1 but increased into 612 in Group 2.

USERS' PREFERENCES

The users were asked which animation (traditional or classified) they thought corresponded better to certain claims or descriptions. These results are presented separately for both user groups in Figure 4.

The results show that the classified animation was more often considered informative, insightful, and easy to understand than the traditional animation by both user groups. This preference is even stronger in Group 2, who saw the classified animation after the traditional one. The classified animation was experienced as being more confusing by Group 1, who saw it before the traditional animation. At the same time, however, the majority of the

Category	Existence			Movement			Time			Word Count
Protocol	appearance / disappearance	number	location	direction	route	duration / speed	relative	absolute	animation	
Group 1 Traditional	8	28	31	4	1	4	9	42	0	291
Group 1 Classified	10	37	33	7	2	2	31	32	4	431
Group 2 Traditional	8	34	64	3	5	3	11	45	0	426
Group 2 Classified	7	73	80	8	2	7	34	59	3	612
Traditional Animation Total	16	62	95	7	6	7	20	87	0	717
Classified Animation Total	17	110	113	15	4	9	65	91	7	1043
Group 1 Total	18	65	64	11	3	6	40	74	4	722
Group 2 Total	15	107	144	11	7	10	45	104	3	1038

Table 2. *The results of the protocols found in the verbal protocol analysis, for each group and animation.*

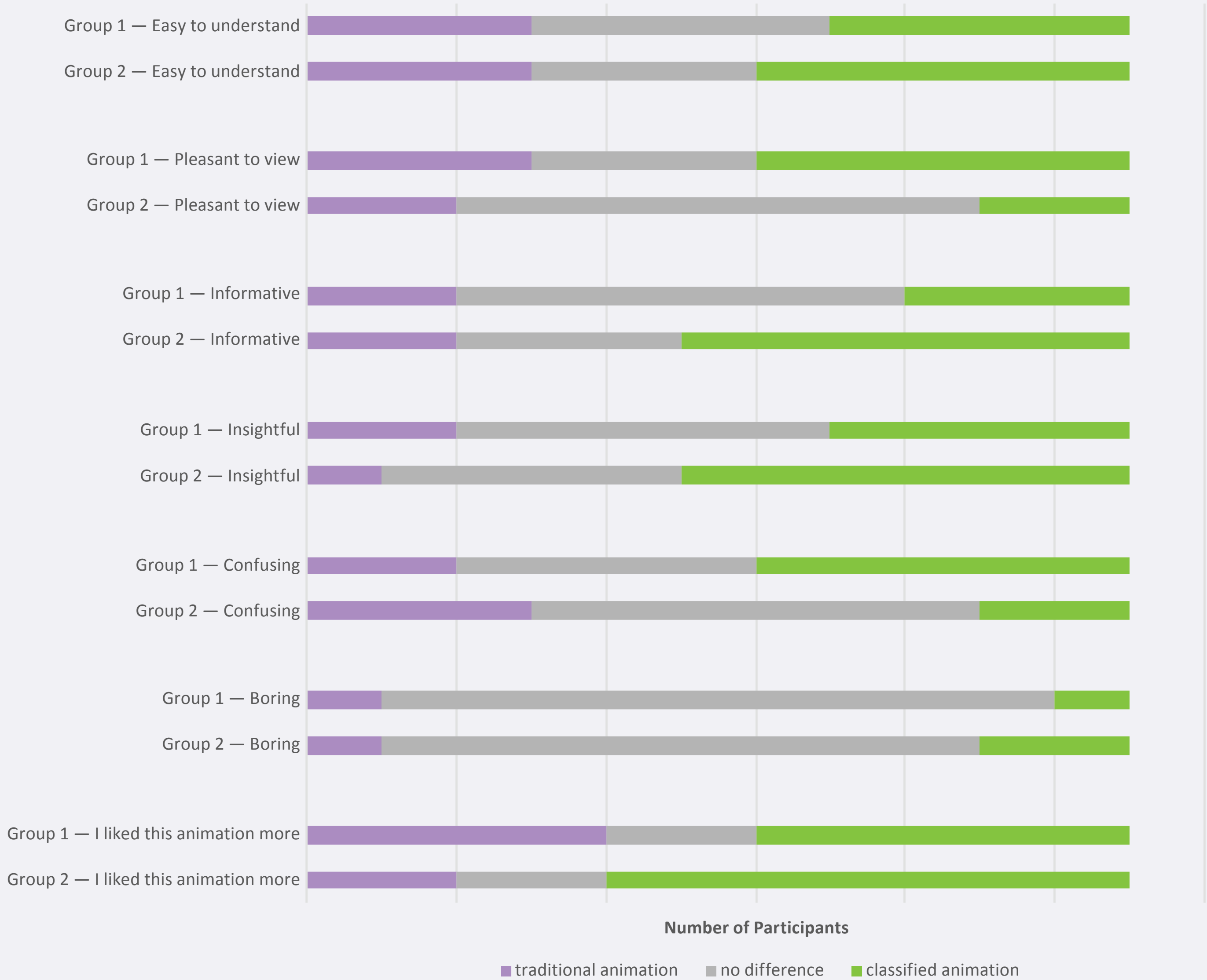

Figure 4. *The users' preferences between the animations. Group 1 viewed the classified animation first and traditional animation after that. Group 2 viewed the animations in reverse order.*

users in Group 1 stated that the classified animation was more pleasant to view.

FREE FEEDBACK

The free text feedback was sorted into the following groups: positive feedback, negative feedback, descriptions of potential use, and mentions of new information gained. These results are shown in Table 3. The classified animation received more positive comments. In both user groups, the animation that was viewed first received more mentions about the potential use cases, but Group 2 made remarkably more mentions of new information than Group 1.

DISCUSSION

The results from the protocol analysis suggest that the way users saw the data affected the way they interpreted it. One might assume that the animation that was seen first would have gained the more extensive description, and as the data in the second animation were the same, users might have a lower motivation to describe the same phenomenon again. However, the test users in Group 2—who saw the traditional animation first and the classified

	Positive	Negative	Potential Use	New Information
Group 2, traditional (first)	0	1	6	5
Group 1, traditional (second)	3	1	3	1
Traditional animation total	3	2	9	6
Group 2, classified (second)	6	1	3	6
Group 1, classified (first)	5	2	7	1
Classified animation total	11	3	10	7

Table 3. *Free text feedback from both user groups.*

animation after that—extended their verbal descriptions after the second animation. Their descriptions of the migration and behaviour of the geese were longer and more detailed. At the same time, Group 1 met our assumption: they saw the classified animation first, and it seems that they did not gain any new information when viewing the traditional animation.

Interestingly, while Group 2 produced more mentions of real-world time and location of the phenomenon, there was not much difference between the groups for the "appearance / disappearance" protocol. Even though the classified animation clearly shows those moments when the number of geese starts to grow, this feature did not encourage the users to mention, for example, the start of the migration. However, the classified animation led the users in both groups to mention relative time definitions more often. It seems that in some way it draws the users' attention to the order of the events rather than to the exact moment.

When the users were asked about their preferences between the animations, the classified animation received positive descriptions more often than the traditional one. The users even found the classified animation easier to understand, despite the fact that the method behind it was much more complex than in the traditional animation. This may have been caused by the continuous change in the colours in the traditional animation, which some users commented on as being confusing.

If the classified animation alone offered enough information for the users, Group 1 should have provided more detailed descriptions of the phenomenon based on the first animation than Group 2, but this was not the case. The word count after the first viewed animation was almost the same for both groups, and it increased after the second animation in Group 2 (traditional, then classified) but decreased in Group 1 (classified, then traditional). This, together with the fact that Group 2 gave more extensive descriptions and gained new insight, suggests that it is meaningful to start with a visualisation that provides an overview of the phenomenon and move to specific aspects of data after that, rather than vice versa. This is in line with the mantra of Shneiderman (1996), who urges data visualizers to offer an overview of the data first before any further examination.

One particularly interesting finding was that in several cases the users said that the autumn migration was located further east than the spring migration, which moves along the western shoreline. This is in line with common knowledge about the migration of geese in the area of Finland. However, with the classified animation, 9 users out of 22 stated that the autumn migration actually had a starting point on the west coast. This behaviour was not seen, or at least it was not mentioned, in descriptions based on the traditional animation. This suggests that the classified animation gave the users a novel stimulus, increasing users' understanding of the phenomenon. The traditional animation did not emphasize the beginning of the migration enough and therefore it only confirmed the previous knowledge that the users had.

The free-word feedback collected from the users supports the findings reported above. The classified animation got more positive mentions, but also one more negative mention. In several comments mentioned how the classified animation opened up new insights and was interesting. This is encouraging, because the test users were familiar with migration phenomenon, rather than being professionals in visual analysis of spatio-temporal information. The classified animation and the new information it brought to the animation were received positively overall, especially in the group that viewed it after they had seen the traditional animation first. They seemed to form a better overall image of the phenomenon, and they benefited from the classified animation more than the other group.

APPLICABILITY OF THE RESULTS

This study presents the temporal classification concept implemented with one dataset. The classification was tailored for the dataset manually with layperson's knowledge of the phenomenon. A systematic approach to the classification concept must be developed, defining specific limits for the increase and decrease, before it can be applied automatically to other datasets. However, any limits may be case-dependent and setting them may require expert knowledge.

This classification method works best with datasets in which the intensity of events changes gradually. If the dataset consists of long steady periods with very sudden stepped changes or short peaks, it is possible that these changes will become invisible in the classified visualization. The length of time that events stay visible will affect the degree to which events of different periods will mix during the animation. This may have a critical role in the readability and interpretability of the animation. Also, many factors concerning the classification process, such as the number of classes and the temporal resolution, affect the outcome of temporal classification. Depending on the choices made during the pre-processing, this method can emphasize very different things from the same dataset.

The steady periods in our dataset were all of the same type, containing relatively low numbers of events. The idea was that the use of grey as a neutral visualisation of steady periods can be associated with the non-interesting, quiet phase of the phenomenon, regardless of the intensity. It must be noted that while steady periods were of low interest in this particular dataset, they might be the most important thing in some other, and in that case the colours should, of course, be selected to highlight those periods.

The test users in the study were familiar with the phenomenon presented in the test animations, rather than with visual analysis tools. Their ages were also biased towards older people, because bird observation is a more common hobby among elderly people. It must be noted that in this age group the experience of computer use varies greatly. Therefore it cannot be supposed that these results will apply in a straightforward manner to all users, although Harrower (2007) questions the existence of differences between novices and experienced map users.

CONCLUSIONS

This study examined a classification method for symbolising animated events on the basis of their intensity and tested the usefulness of the symbolization for visual analysis. The area of the dataset was divided into spatial zones based on the assumed spatial behaviour of the phenomenon. After that, the events in each zone were classified into periods of increasing, decreasing, and steady intensity, and coloured according to those classes. An animation of the temporally classified dataset was tested together with another animation, in which the same dataset was coloured continuously across the time period. The test users described the phenomenon the animations presented and marked their preferences between the two animations.

The study indicates that temporally classified animation can be informative, insightful, and add a new perspective to animated data in analysis. In the user test, the classified animation led to richer analysis, especially with the group who saw the traditional representation before it. The users made positive comments on both animations, but especially the classified animation. However, the suitability of the temporal classification for datasets with different spatio-temporal structures has to be studied further before it can be promoted as a systematic approach. Formal definition of the classification, as well as the influence of areal division, is an ongoing project in our research group.

The study also suggests that the full potential of these animations can be reached by offering users both a traditional animation to get an overview of the phenomenon and a temporally classified animation for further analysis. This is in line with previous knowledge (e.g., Shneiderman 1996) that discusses the importance of first offering an overview of the phenomenon to the user. The user uses previous knowledge when building new knowledge and this is done better when the user first has an opportunity to familiarize themselves with the phenomenon without any additional information. On the grounds of these theories and the results of the study presented here, it is recommended that the traditional animation is viewed first and a more complex temporally classified animation after that.

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The Lionel Pincus and Princess Firyal Map Division: Expanding Access through Transformative Projects at the New York Public Library

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The Lionel Pincus and Princess Firyal Map Division is the primary cartographic collection in the Stephen A. Schwarzman Building (Figure 1), one of four research libraries in the New York Public Library system. With origins reaching back to the formation of the research library at the end of the 19th century, the Map Division is a quintessential New York institution: its collections have been formed by the intellectual, political, artistic, and ethnic elements of the city's history. As such, it is the documentation of the city's growth and development over the centuries that comprise the driving force behind our collection development strategy and our digital strategy.

An early historian of the library describes the primary purpose of the Division to be that of "building the collection to secure maps which will help solve the everyday problems of the reading public" (Brown 1941, 253). While fulfilling this aim is admittedly a moving target, the Map Division, its collections, staff, and programming have kept apace of trends and transformations in research and in addressing the needs of its community of researchers. Currently, the holdings stand at approximately 433,000 maps; 28,000 atlases; gazetteers and monographs; globes; and a good deal of odds and ends, such as jigsaw puzzles, postcards, magnets and other "carti-facts." While some pieces in the collection date back to the late 1500s, the bulk of the collection starts in the mid-17th century and continues to the present day. This enormous range of materials runs the gamut, from treasures of the golden age of Dutch cartography, such as Blaeu's *Atlas Maior* (Figure 2), to the city's most recent bicycling map. Historically, the Division has collected cartographic material on the global to local scale, with our deepest collections being those

Figure 1. *Lionel Pincus and Princess Firyal Map Division Reading Room at the Stephen A. Schwarzman Building.*

Figure 2. *"Nova Belgica et Anglia Nova." 1662. From Joan Blaeu's* Atlas maior, sive, Cosmographia Blaviana. *digitalcollections.nypl.org/items/510d47da-ef37-a3d9-e040-e00a18064a99.*

materials covering the areas of the United States, the Mid-Atlantic states, and New York City. Recently, the Division has fine-tuned its collection development policy: while renewing our commitment to complete global coverage at a scale of 1:250,000, we began to focus most of our acquisition activities on contemporary and historical collections that build upon our rich holdings of local historical cartographic materials.

BRINGING THE COLLECTIONS ONLINE: AN EVOLVING DIGITAL STRATEGY

The New York Public Library is justifiably proud of the complete accessibility of its historical collections; its holdings are open to all members of the public with an interest in research, regardless of institutional affiliation, or lack thereof. For the first ninety years of its existence, one merely needed to show up and speak to a librarian to access the map collections. With the inception of the library's digitization program in the late 1990s however,

Figure 3. *A map from the Slaughter Collection:* Virginia, Marylandia et Carolina in America septentrionali Britannorum industria excultae / repraesentatae à Ioh. Bapt. Homann, S.C.M. Geog. *1714–1730[?]. digitalcollections.nypl.org/items/510d47da-eeab-a3d9-e040-e00a18064a99.*

Figure 4. *"Plate 10: Map bounded by Chatham Street, James Street, South Street, Dover Street, Franklin Square, Frankfort Street, Fose Street, Duane Street." William Perris, 1857. digitalcollections.nypl.org/items/510d47e0-bf3f-a3d9-e040-e00a18064a99.*

even this lightest of requirements, that of being physically present, began to diminish in importance. Then as now, our digitization efforts were primarily grant funded and our early scanning projects served to bring unique and heavily accessed collections online, such as the stunning Lawrence H. Slaughter collection of English maps and atlases (Figure 3) and thousands of sheets from our fire insurance and county atlases of New York and New Jersey (Figure 4). Bringing the collections online not only allowed us to exponentially expand access to meet the expectations of our researchers, it also set the stage for further public engagement and reuse of these digital assets.

After nearly a decade of scanning maps and placing the images online for perusal, the library began to develop a more comprehensive and researcher-focused digital strategy. The Map Division, led by former curator and Geospatial Librarian Matt Knutzen, and supported by the NYPL Labs department (**nypl.org/collections/labs**), began to understand digitization not as an end, nor solely a means to bring the collections to remote users, but as the first step in a process that would allow for new forms of user interaction with digital maps (Vershbow 2013). We began to see ways to generate entirely new pathways to the information embedded in maps. Our ambitions coalesced in the idea of creating a historical gazetteer of New York, a tool that could be described as a kind of Google Maps for exploring the city's history. This atlas would enable the user to query and engage with historical maps of New York City, exploring the institutions and businesses that existed in it, tracking its changing infrastructure, and meeting the people that lived in the city at different points in time. This idea provided the framework within which subsequent public-facing mapping tools and projects took form and has since shaped our cataloging, processing, and digitization work in recent years.

The first step in this strategy was to build up our digital map content, focusing on the most heavily requested public domain collections, namely our maps of New York City. Through successive grants, the library scanned nearly 15,000 sheets from our New York and New Jersey collections of maps and atlases, including fire insurance atlases, farm maps, transit maps, and nautical charts (Figure 5). At the same time, the Division developed a public-facing tool called the Map Warper (**maps.nypl.org/warper**; Figure 6) that facilitated geographic access to these digital images through a process called georectification. In this process, staff and volunteers, with a few clicks, could align a digital image of an historical map with coordinates on a contemporary digital map. This work transformed static image files into geographically accurate historical maps. Taken together, they formed a series of historical base maps for New York City, covering centuries of urban life and development. These maps, transformed by the Warper's tools, would provide the foundation for the historical atlas and gazetteer.

After the initial launch of the Map Warper in 2010, the library began to incorporate new processes into its suite of tools, specifically cropping and tracing. The first of these actions served to rid the rectified map of its marginalia

Figure 5. *"Map of the Borough of Brooklyn showing location of racial colonies." 1920. digitalcollections.nypl.org/items/ff3b6210-d2ad-012f-97ad-58d385a7bbd0.*

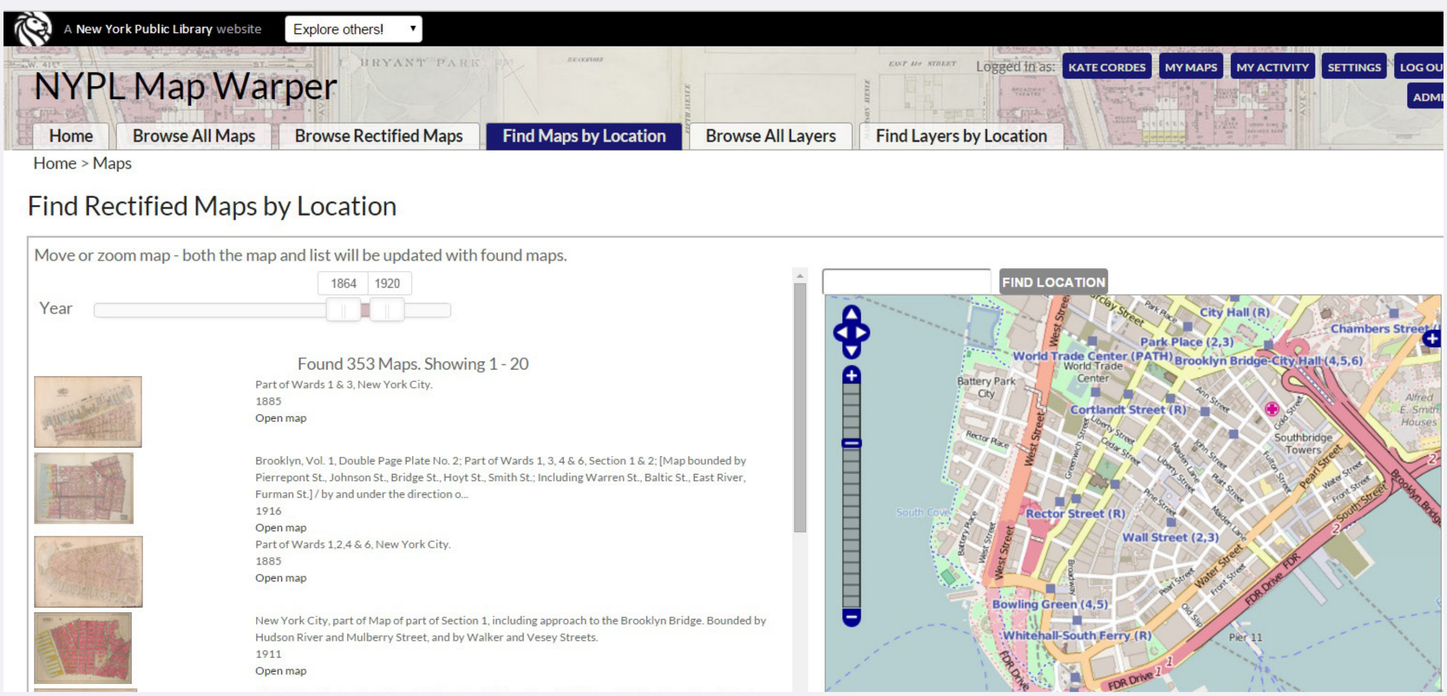

Figure 6. *Map Warper screenshot, maps.nypl.org.*

and non-cartographic information, while the second served to extract data, such as building footprints on property maps. A few years later, the data extraction process was given a tremendous boost when the NYPL Labs team developed the means to automate the labor-intensive tracing task, and launched the "Building Inspector" site in the fall of 2013 (**buildinginspector.nypl.org**). This tool focuses the user's energy on cleaning up the automated tracing work, extracting address information and other building data, and transcribing the names of the thousands of business, church, and institutional names, the majority of which have changed many times over (Figure 7).

Figure 7. *Building Inspector screenshot, buildinginspector.nypl.org.*

In 2014, an award from the Knight Foundation provided the funding necessary to jumpstart the historical atlas and gazetteer project, which is now called the NYC Space/Time Directory (**spacetime.nypl.org**; Figure 8). Though today the project is still in its infancy, within a few years this searchable atlas will incorporate our georectified historical map collections and the data that thousands of online volunteers have extracted from those maps, such as defunct business names, shuttered restaurants, and locations of paved-over streams and creeks. The possible uses of this research portal are numerous. Through the Space/Time Directory, users will be able to rediscover place names long since erased from living memory, search for Roman Catholic churches in early 20th century Brooklyn, locate Gilded Age hotels on actual maps produced during the late 19th century, or call up an image of all the small cemeteries scattered throughout Queens County in 1900. Beyond the massive amounts of data extracted from maps, the Space/Time directory aims to incorporate other historical collections from the research library, materials that have some geocodable elements in them, from photographs of buildings, to menus, and institutional records in our archives. Our goal is to provide researchers with a temporally and spatially accessible catalog—one that would allow a genealogist to search for all the Catholic churches within one mile of an ancestor's house, and then to pull up the catalog record and links to archival records for that church. Similarly, a historic preservationist could review property maps of a particular block, then pull up photographs of the buildings and other records regarding the neighborhood's history that the library might have in its collections.

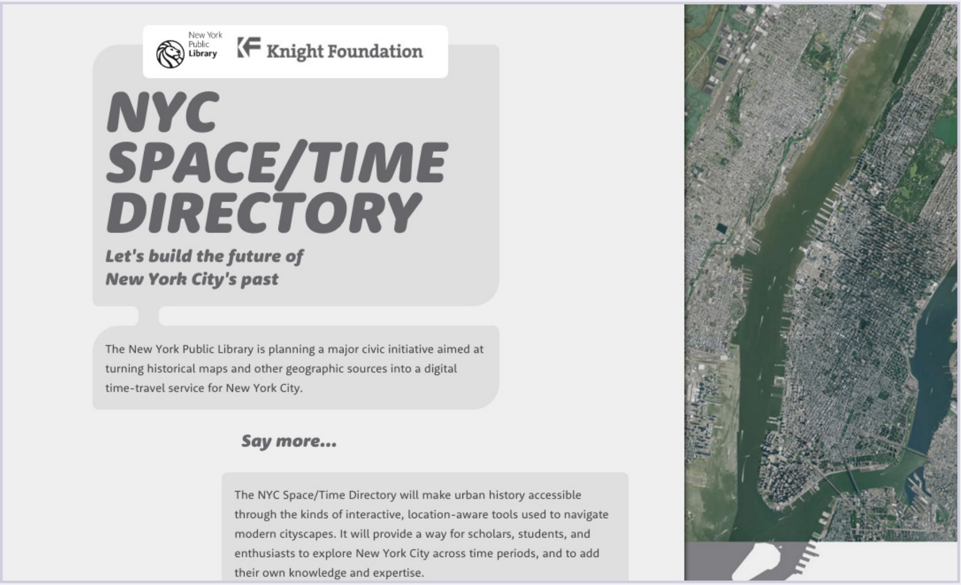

Figure 8. *Space/Time Directory screenshot, spacetime.nypl.org.*

The Space/Time directory is at its heart a mapping tool—one that was built and developed around the Division's cartographic collections. It has taken us beyond the physical transaction of delivering maps and atlases in the reading room, to the digitization of maps, through the extraction of place-based data, and towards an open-source platform that will facilitate new discoveries and will reveal an entirely new historical and geographic context for the New York Public Library's collections. Our hope and our guiding principle remains that of our predecessors: to assist our "reading public" with their research needs by providing an innovative and intuitive portal for navigating and accessing historical collections and data sets by means of a familiar interface: the map search.

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Peer-Evaluation Techniques: Classroom Strategies for Editing and Improving Student Work

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INTRODUCTION

Students learn important cartographic design principles when they are able to think critically and actively engage in map design evaluations. Having students critique their peers' maps can be a useful teaching technique, reinforcing a student's own learning by prompting them to assist and instruct others. I employ two strategies in the classroom to generate peer evaluations that do not take too much time, yet have a big impact on student projects. First, I try to keep them fun and brief, yet focused and directed. Second, I ensure all feedback is student-driven: students tend to share similar technical terms, jargon, and knowledge that put them on an equal level of understanding, as compared to the specialized comments often used by faculty members. I find students generally feel less intimidated by feedback from other students than from a professor.

Student maps improve greatly and learning outcomes are more often achieved when students are required to revise and edit their assignments. However, grading weekly lab assignments limits an instructor's ability to provide immediate feedback to students on their maps. Much of the time grading these assignments is spent on initial observations about overall design and balance, hierarchy of information, proper symbol choice, clarity of information, and the dreaded overbearing north arrow, rather than more detailed comments about position of text, variations in color saturation, or even grammatical written errors. Editorial remarks are usually given back to students a few days later in the next class period. Despite presenting the class with overall comments, examples of good and bad work, and encouragement to improve their maps, the majority of students rarely touch an assignment after it has been graded and returned. I have found peer-evaluations are an effective way to overcome these problems in my cartography course.

GEO 352: CARTOGRAPHY

I teach a 300-level course titled "Cartography," which is mostly comprised of sophomore and junior undergraduate students. The majority of students are geo-environmental majors and select cartography as one option out of a group of required technique courses including GIS II, Remote Sensing, Quantitative Methods, and Field Methods. The course is capped at 20 students, limited by the number of computers in the lab. It is taught in a computer lab twice a week for an hour and fifteen minutes. I begin the class time with a 20–25 minutes lecture, followed by 10 minutes of demonstration of an applied computer skill, and then individual work on hands-on assignments. Despite the course not having any pre-requisites, the students are highly advised to have completed GIS I, so that they have a basic understanding of ArcGIS and some fundamental concepts of representing features in a spatial context. Many of the activities build on their ArcGIS knowledge, while developing new skills in a graphic design package such as Adobe Illustrator.

During the course of a semester, I stress the development of effective graphic communication through both short- and long-term projects. Ten weekly assignments allow students to gain skills in ArcGIS and export their maps into

Illustrator to enhance and present concepts. For example, in one activity students select a single socio-demographic variable from one state and classify the county-level data using three different methods (Jenks, equal interval, and quantile). They are then asked to display all three methods in a one-page infographic that includes the resulting maps and information such as where breaks occur and the number of observations in each category. Students can present the results in writing, but they are encouraged to explain their work visually in diagrams, graphs, or charts.

Semester-long projects have more variation, with individual students mapping different topics, with their selection guided by real world needs based on requests from organizations. For example, recent projects have focused on an educational brochure about stream restoration, Pennsylvania DCNR online camping reservations, and NOAA's Flower Garden Banks Marine Sanctuary. Their final project should include a large-scale map, a regional locator map, scientific data that may be presented in charts or graphs, photographs, diagrams, and a range of text, amongst other items they feel are relevant. By the end of the semester, students should have several high quality maps from both short- and long-term projects that demonstrate their ability to collect, manage, organize, and display spatial data in both GIS and graphic design programs, and which are worthy of keeping in a portfolio for potential employers.

APPROACH TO PEER-REVIEW

Evaluations of short weekly activities benefit from quick, brief peer-review comments. By combining relatable elements of pop culture with recently learned class concepts, students receive feedback on their own work and gain skills in map reading by critiquing others. Taking a cue from the latest craze in fitness watches, after students have been working a while, I tell them to save their work, for it is time to stand. Students walk around the room looking at each project for 15–20 seconds. We stress the slogan students know from the influx of new Planet Fitness facilities in their area: that the classroom is a "Judgment Free Zone." With only a few minutes of class time used in this activity, a quiet lab setting becomes a room of discussion where students can laugh at mistakes, see fresh ideas, and freely shout out things they like and didn't like. Occasionally, if students need more than just several seconds of glancing at ideas, and the projects would benefit from a few written peer-review comments, we do the Cha Cha Slide. Again, after saving their work, students stand and are directed to "take a step to the left, three steps to the right, clap their hands, and take it back now y'all." While not trying to torture students with my poor singing voice, I change my directions and number of steps to create an unpredictable way to have them stop and sit at just one or two computers. While in front of that computer they need to provide written feedback on a specific topic or particular concept pertaining to that assignment.

The semester-long projects benefit from multiple edits with guided criticism. Students are warned a week or two in advance of evaluation days. On those days, students have a few minutes to open their work, make any changes, and save their files. I give each student a piece of paper with topics pertaining to their map, and a dividing line between "Needs Improvement" and "Looks Good" as seen in Table 1. This paper remains in front of each computer. Students are encouraged to take their own pen to avoid spreading too many germs as they move around the room. After a minute or two, I yell, "switch," and they move along to the next computer. The directed topics may change as the semester goes along, but each time students can make comments on what is good about the map and what they may find confusing or distracting. They can draw suggestions of other images or graphs that might make the project more interesting, and they can elaborate on someone else's comments. Within twenty to thirty minutes every project has a wealth of suggestions.

An example of the evaluation process comes from a student's map of the Gulf of Mexico that included a food-chain ecosystem diagram, pictures of animals, and their mapped habitats. The concept was good but the overall design was not clear. Comments offered by students include phrases such as "the text on your animal wheel is a little too small," "maybe clearer text, a larger font, and stronger arrows would clarify that these animals are connected in an ecosystem," and, "the wheel of the animals stands out but the maps of where they live are too small and aren't noticeable," and helped this student reorganize his topic. The result was a clearly labeled wheel, with distinct maps of each habitat and a related picture of each animal.

	Needs Improvement	Looks Good
Overall Layout and Balance		
The Main Map		
Inset		
Charts/Graphs/Pictures		
Color		
Supporting Text Blocks		

Table 1. *A peer-review example page.*

Ideally, as the semester progresses and improvements are made, the dividing line between the good and bad map qualities on the paper shifts. Initially, the greatest improvement comes from the student's use of space and what I refer to as a "brain dump." On the first draft, most students tend to put everything on the page with little thought of organization or overall balance. The initial map drafts will tend to have a lot of unused space, unnecessary written information, and randomly placed objects such as north arrows, insets, and pictures, all of which create disjointed and distracting projects. During the first peer evaluation, these students receive repeated comments from multiple students about their use of space; these comments, along with their own critical observations of other projects, prompt students to make significant improvements to their overall presentation of information. With a better layout, the succeeding evaluation days tend to focus on critique of appropriate methods of displaying data, and creative designs.

ASSESSMENT OF PEER-REVIEWED RESULTS

Students are required to hand in these evaluation sheets alongside their final project, and they are assessed as part of the final project grade. First, the collection of evaluation sheets demonstrates the level to which a student edited their own work. If the same comments are repeated on multiple evaluation days, clearly the student did not understand the concept or they chose not to make improvements. Second, students are encouraged to place their initials after their written comments on the evaluation sheets. I use their collective comments as part of a participation grade. I do not expect them to provide elaborate insights into every student's project, especially if they are the 20th person to evaluate the map, but simply writing "nice map," "cool pictures," or "I like the blue background" on every paper does not constitute an acceptable level of active participation.

CONCLUDING THOUGHTS

Besides helping students learn about map design, these peer-review techniques also aid in several significant and substantial classroom management issues. First, there is a noticeable lack of excuses for not having work completed. Typically, students do not make the sort of excuses to other students that faculty commonly hear, such as family emergencies, lost storage devices, and forgotten homework. Additionally, peer-evaluation days make students start projects earlier, rather than leave assignments to last minute. Generally, one or two students will not have their assignments for the first evaluation day, but they can still participate in providing feedback to others, and they make sure not to have that experience happen again. Second is the minor adjustments or corrections to assignments. Despite clearly written instructions and learning objectives, undoubtedly someone will not follow directions. The time-to-stand activity allows those students to identify their mistakes and provides those who do not quite understand the assignment a chance to ask questions. It gives everyone the opportunity to see a variety of ideas before the class period is over, while still leaving time to make adjustments. Third, any sign of plagiarism, cheating, or blatant lack of effort is handled immediately upfront. Taken from an ESPN *Monday Night Football* segment that makes fun of the worst plays of the weekend, the class has started "C'mon Man" to highlight any subpar effort. In a fun, joking manner in the judgment-free zone, students love to yell out "C'mon Man," which results in the identified student improving their assignment by the next class period. Finally, these activities create a team-building atmosphere. The supportive relationships that develop extend to all projects and students feel more confident in assisting other students and working together to solve problems, and overall, they gain a more satisfied feeling of achievement.

In summary, while the students' projects still range in quality following these edits and classroom techniques, the peer-evaluations force students to improve their map reading skills, and chances are that if they have examined, evaluated, and critiqued design concepts of their fellow students' work, they will make similar edits and improvements to their own maps.

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The Tangible Map Exhibit

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The Tangible Map Exhibit highlighted the importance of tangible, physical works in modern cartography and celebrated visually stunning, artistic maps created by contemporary makers. The exhibit was a part of the Map Gallery at the 2015 NACIS Annual Meeting in Minneapolis, Minnesota, which was open to the public for the first time ever. It featured over fifteen works created by more than a dozen cartographers across North America and beyond.

Tangible, physical maps continue to play an important role in contemporary cartography. They provide a platform for investigation, an outlet for creative expression, and help break down barriers to access. Tangible works also provide a means to inform digital design in ways that honor deeply rooted traditions in cartography. They complement, rather than counter, digital cartography, as many of these pieces were made leveraging digital tools by makers who are proficient using current technologies.

Tangible interactions between maker, place, and medium enhance our understanding of the environment and can facilitate a reverence for the places being represented. Through a process of slowing, stopping, observing, experiencing, and contemplating, a maker can engage in a thoughtful and intentional mapping practice that is sensitive to interconnectedness and strives for a non-objectified relationship with place. Working in a physical medium also provides an outlet for creative expression. By making in a new, unfamiliar medium, we can create judgment-free spaces that allow for experimentation, risk-taking, and the unexpected.

Likewise, physical media encourage tangible interactions between users and maps. This allows mapmakers to engage with a larger audience, and in some cases, help create open public platforms where multiple voices can be heard. Similarly, physical works might offer an invitation to play, explore, or to expose our current relationship with natural systems. By introducing ambiguity through omission, manipulation, or by re-imagining spatial relationships, we offer room for multiple interpretations and create environments where different explanations and perceived meanings are seen as legitimate.

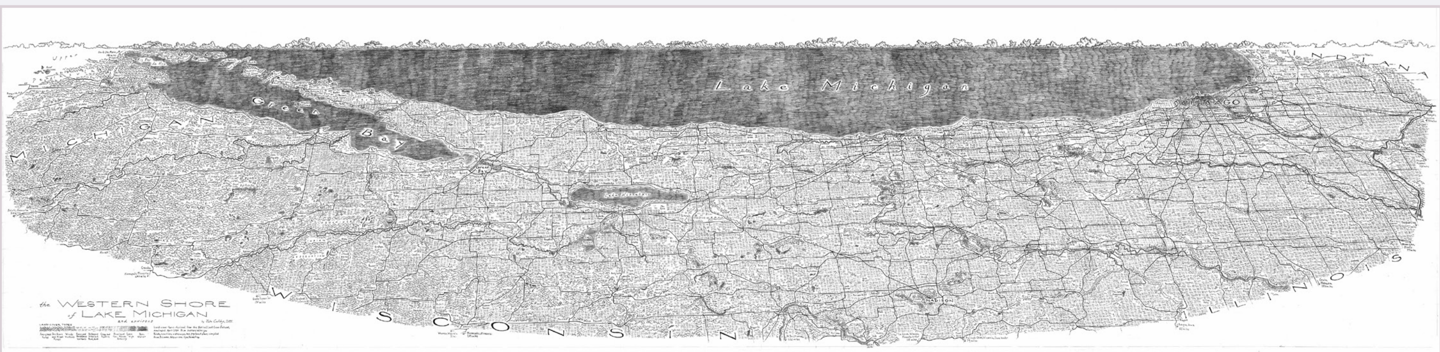
Perhaps most importantly, digital products continue to be inaccessible to significant portions of the population. Tangible maps, such as tactile maps for the blind, provide access for people without digital toolsets and challenge a visual bias in cartographic design. Other formats, such as kiosk maps, put relevant information in direct public view, therefore functioning as a political agent.

While varied in content, approach, and media, these works attest to the dedication, tenacity, and thoughtfulness of NACIS members and others who create tangible work that speaks to the continued relevance of physical media in contemporary cartographic practice.

For full maker statements, as well as additional media, visit **tangiblemapexhibit.blogspot.com**.

THE WESTERN SHORE OF LAKE MICHIGAN AND ENVIRONS

Jake Coolidge. 2015. Ink and graphite on paper. 15"×60".



"I create maps by hand that invite viewers to consider the expressive capabilities of maps and the hand of the cartographer in shaping their visual outcomes. All maps, however produced, are human creations and should be engaged with and interrogated accordingly."

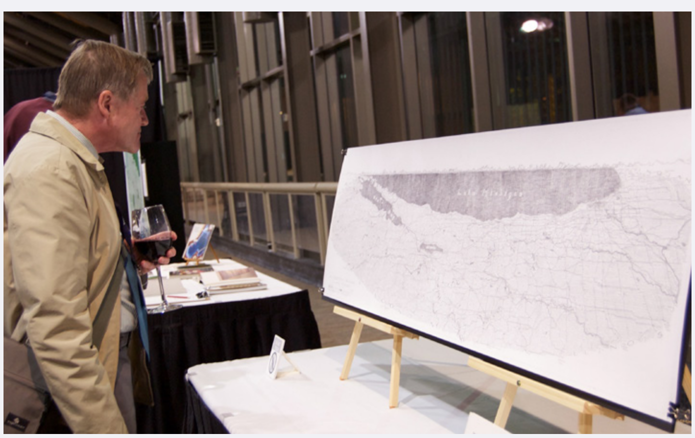


Photo by Dylan Moriarty

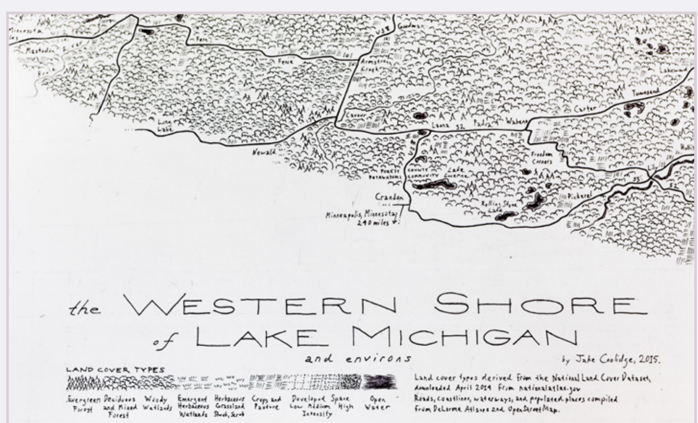


Photo by Charles P. Rader

BAD RIVER-WETLAND MEDICINE RIVER: INTERACTIVE FLOOR MAP

Jessie Conaway with the Bad River Band of Lake Superior Ojibwe. 2015. Printed vinyl. 20'×30'.

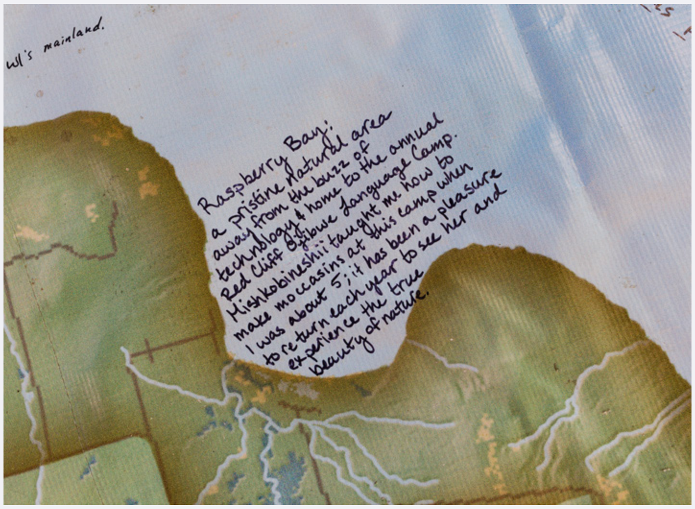


Photo by Charles P. Rader

"… the floor map is an open public platform. Map contributors hold water features and indigenous voices front and center. We represent water vibrantly. Storymapping honors Ojibwe traditions of the educational and cultural values of storytelling. Participatory mapping assuring that many voices are represented."

Photo by Matt Dooley

Photo by Matt Dooley

TRACES I

Jeannine Kitzhaber. 2015. Mixed media on canvas. 48"×72"×3".

Photo by Charles P. Rader

> "While commuting for my job, I began a tangible journal of my travels as a way to make sense of my busy workday and to chronicle the ever-changing landscape."

Photo by Dylan Moriarty

Photo by Charles P. Rader

TACTILE MAP SYMBOLS ACROSS THREE MEDIA

Megen Brittell, Amy Lobben, Megan Lawrence, and Manny Garcia. 2015. 3D printing, microcapsule paper, embossed paper. Multiple sizes.

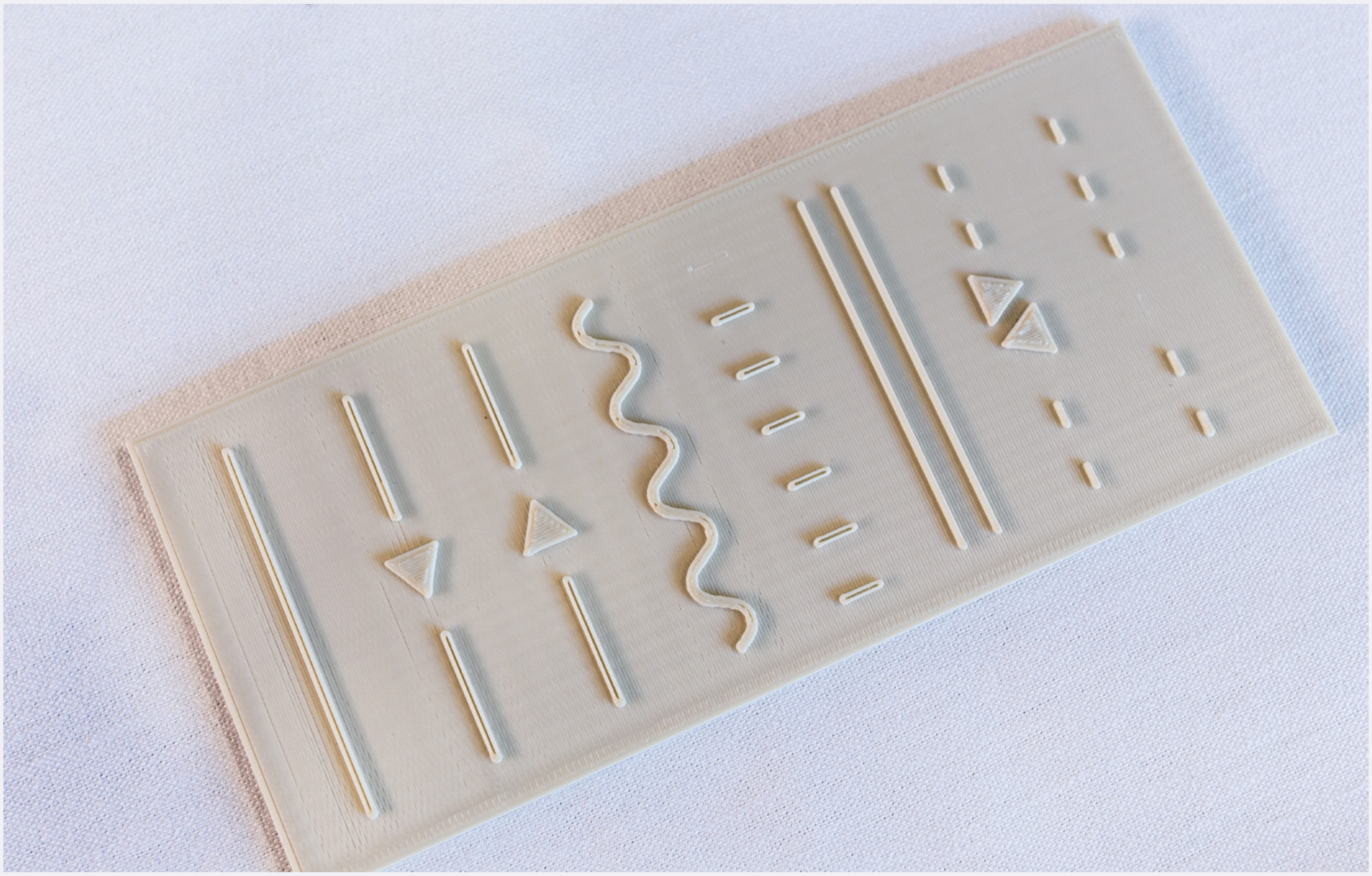


Photo by Charles P. Rader

> "A visual bias in cartographic design has rendered many maps and the information they contain inaccessible to people with visual disabilities. Tactile maps provide one mechanism by which to address the need to make maps and geospatial data more accessible."

Photo by Dylan Moriarty

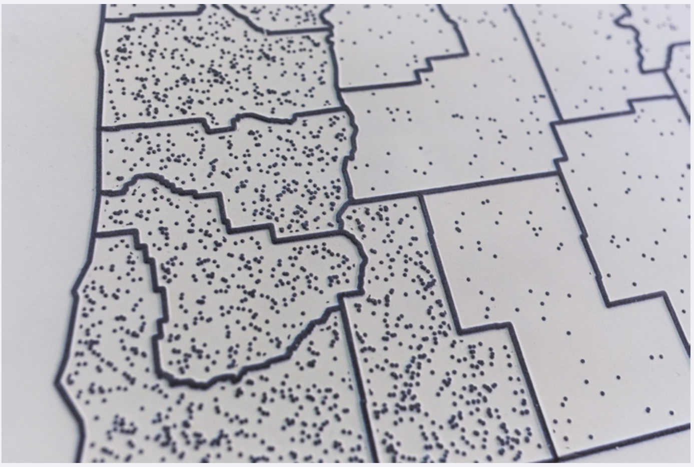


Photo by Charles P. Rader

COMING TOGETHER I & II

Steven R. Holloway. 2015. A suite of two artist-editioned lithographs. Ea. 40"×30", ed. of 7.

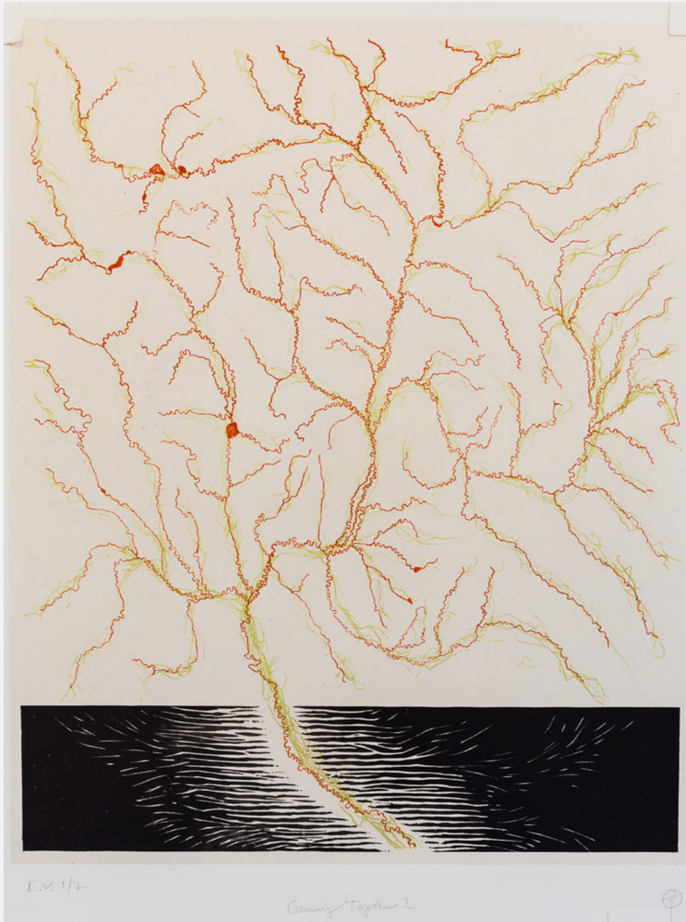


Photo by Charles P. Rader

Photo by Charles P. Rader

"I stop, and observe and experience the place, the other. Stopping is, it turns out, difficult and takes a great deal of patience and practice. How do you stop? There are many ways but they all involve effort and practice. And really good stopping means making many many efforts, repeated over and over until you have entered into and experienced the place itself. And felt and enjoyed and got wet and dirty and cold and sun cloud water exposed. Then make a response."

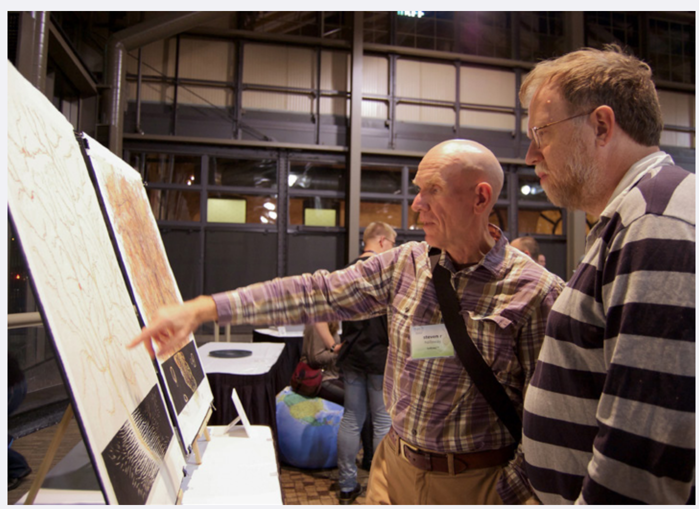


Photo by Dylan Moriarty

BATHYMETRIC BOOK

Caroline Rose. 2012–Present. 1st Edition: inkjet printing and blue paint on paper, Japanese stab binding. 2nd and 3rd prototypes: laser-cut paper in a Coptic binding, magnet closure. 8.5"×5.5"×0.5".

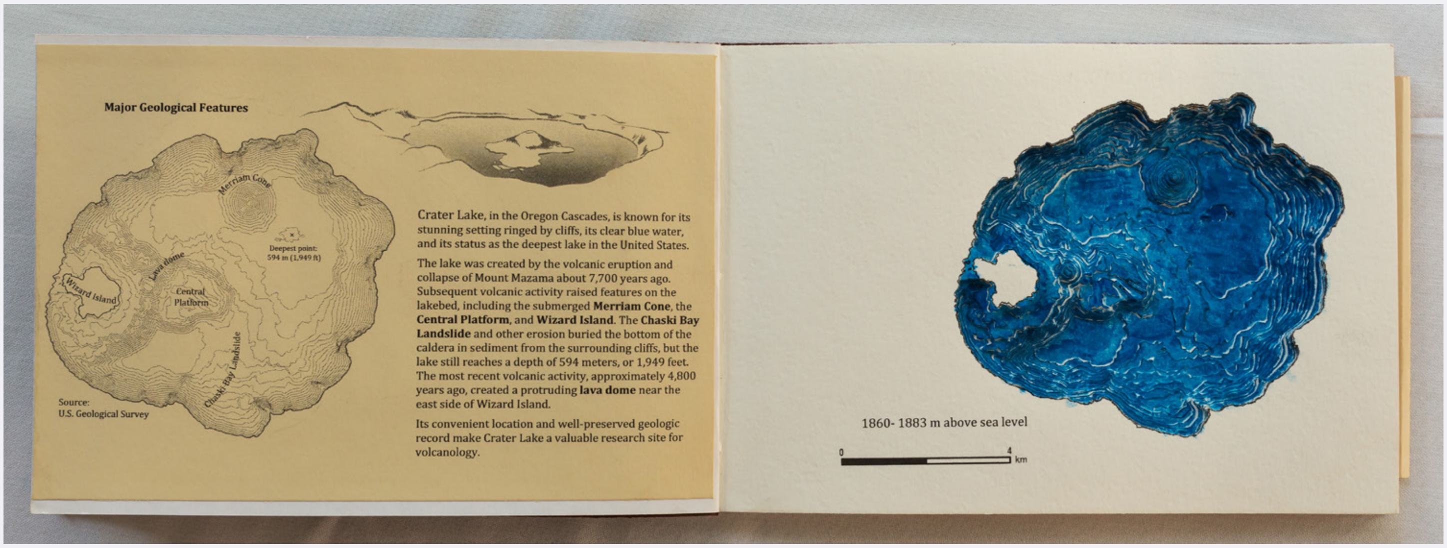


Photo by Charles P. Rader

"I hope that the reader will be prompted to 'look below the surface,' thinking about the processes that form a physical landscape, contemplating how unseen dimensions of the lake are revealed by scientific study, and feeling inspired to visit fascinating places like Crater Lake."

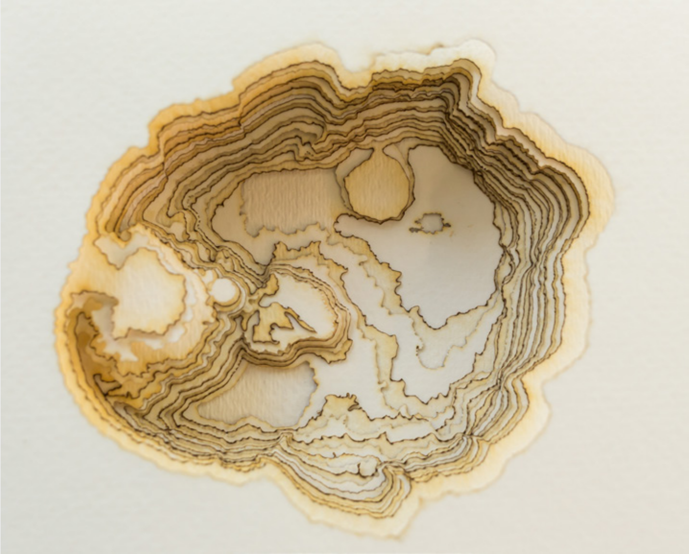


Photo by Charles P. Rader

Photo by Dylan Moriarty

BALANCEPLANET

Hans van der Maarel and Mac Reijers. 2015. Printed spandex, rubber, air. 30"×30".

> "You can't help but play with the BalancePlanet! It's meant to be used, to be touched, to be spun around. Thanks to its bright colors both young and old are attracted to it and can use it to learn about geography."

Photo by Charles P. Rader

Photo by Dylan Moriarty

Photo by Charles P. Rader

TERRESTRIAL

Matt Dooley. 2014. Ceramic. 50"×60".

Photo by Charles P. Rader

"Working at a slower iterative pace has challenged my mapping practice in several ways. It provides time for contemplation about the act of mapping itself, as well as the places being represented."

Photo by Charles P. Rader

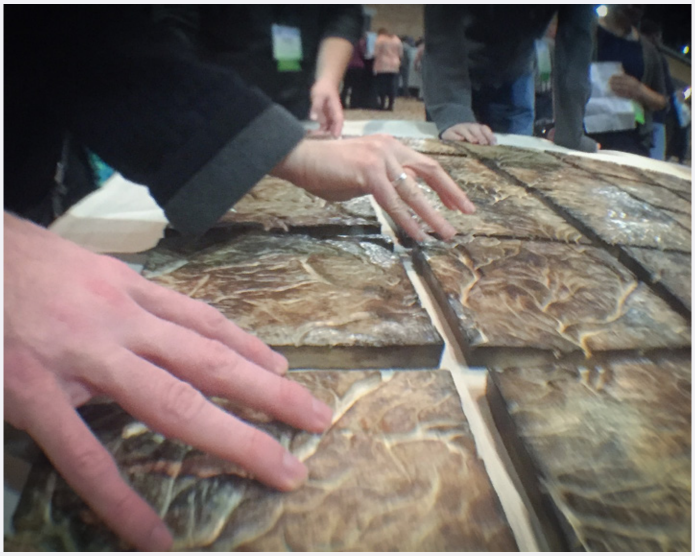


Photo by Matt Dooley

MOHAWK WATERSHED / UPPER HUDSON WATERSHED

Lauren Rosenthal. 2011. Hand-cut watercolor paper, wood, steel, paint. Left: *Mohawk Watershed*, 14.5"×21". Right: *Upper Hudson Watershed*, 13"×15".

Photo by Charles P. Rader

> "By giving priority to rivers, not as resources to be exploited, but as an integral part of social/biological systems, I hope to provoke dialog and stimulate change around how we understand ourselves in relationship to the hydrological world."

Photo by Charles P. Rader

PUBLIC GREEN/AREAS VERDES PÚBLICAS

Lize Mogel. 2001. Silkscreen on Opallene. 48"×70".

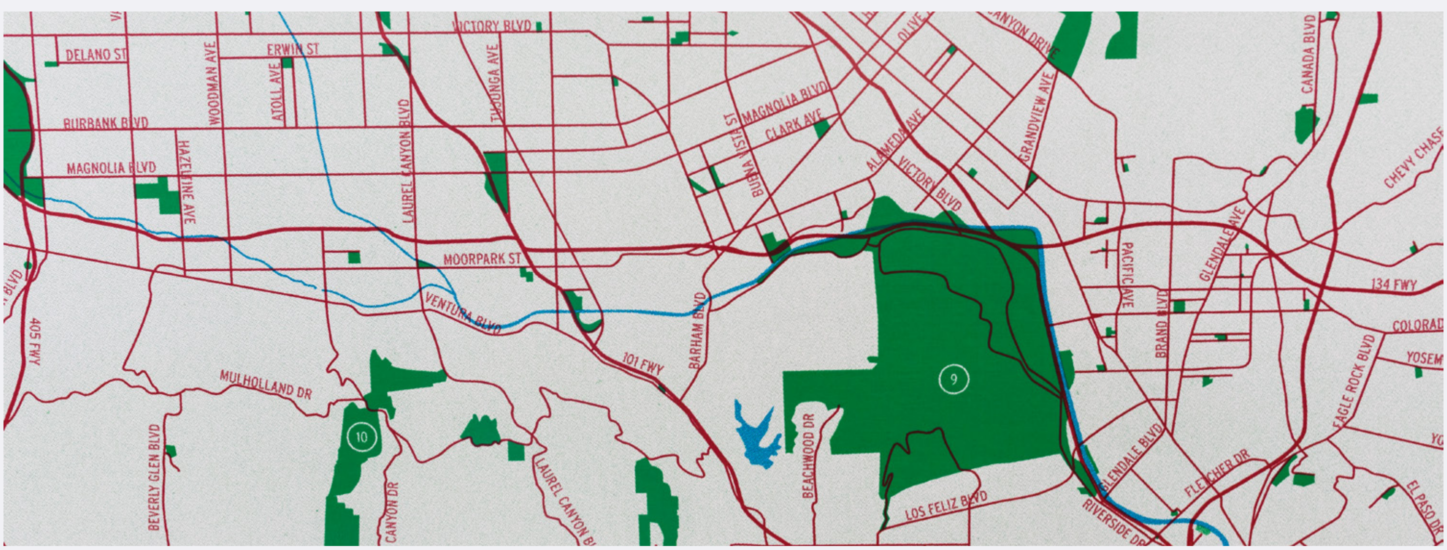


Photo by Charles P. Rader

"For me, 'tangibility' and 'interaction' is about access—not just to information or ways of thinking about a place, but to the means to change the nature of place. In 2001, specialized cartographic knowledge about the city was inaccessible to most people."

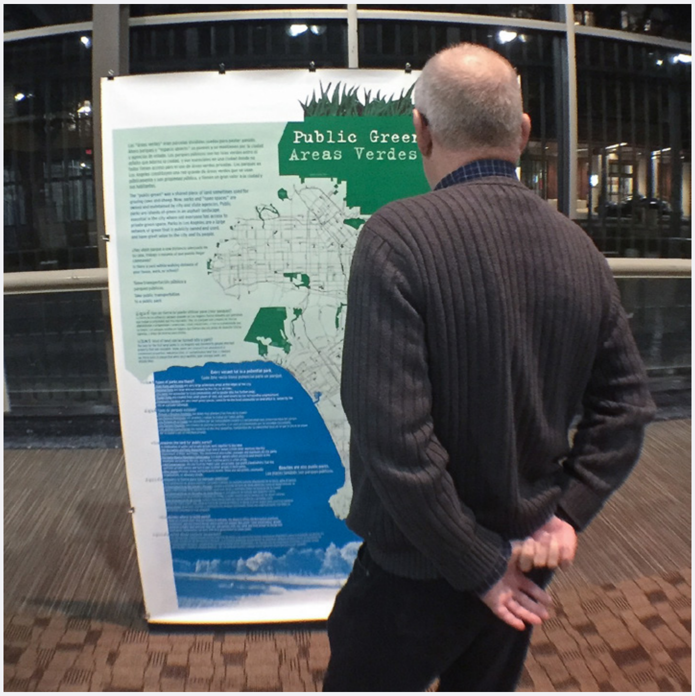


Photo by Matt Dooley

PORTLAND BRIDGES AND PORTLAND BRIDGES II

Nick Martinelli with Christopher Adams. 2014–2015. Screen print and letterpress on paper. Ea. 18"×12".

Photo by Dylan Moriarty

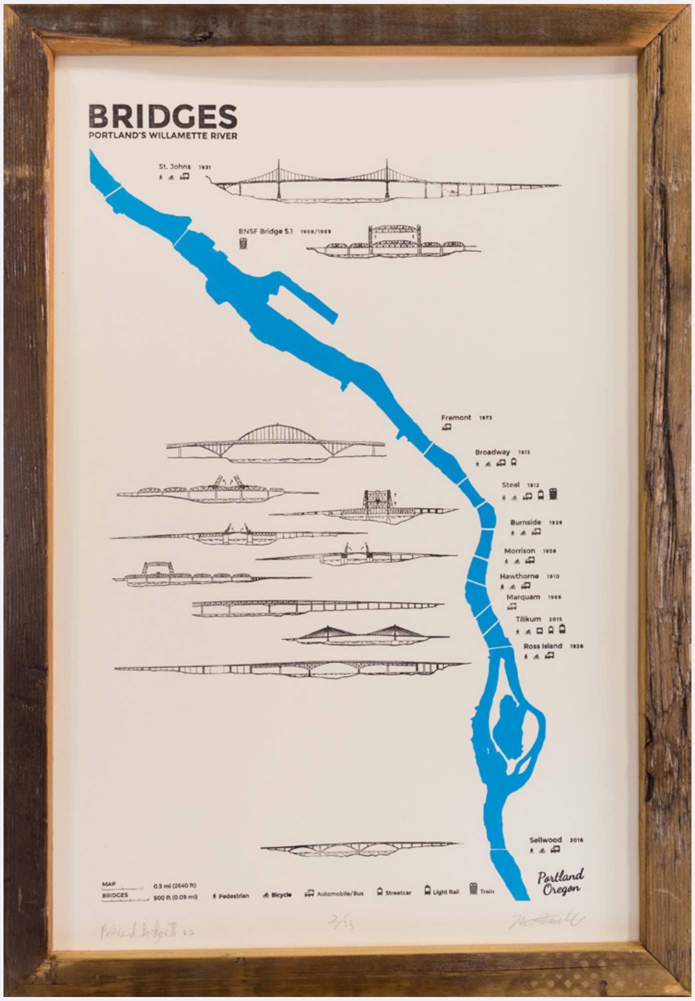


Photo by Charles P. Rader

"The Portland Bridge Map is based on the simple idea that most street maps do not convey the personality of bridges…. In the end, we achieved our goal of producing fine quality hand printed maps and rejuvenating a century-old letterpress machine."

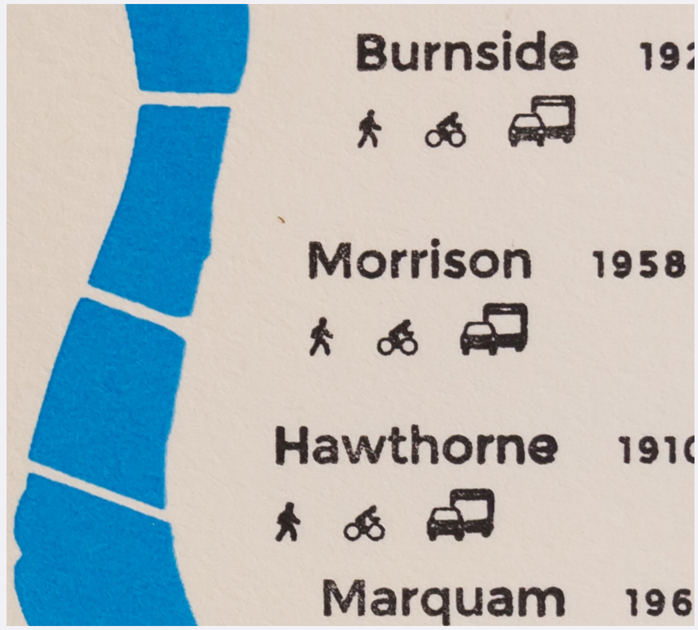


Photo by Charles P. Rader

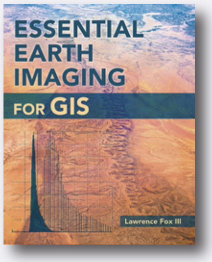
ACKNOWLEDGEMENTS

We would like to extend our appreciation to Susan Peschel, Amy Griffin, Martha Bostwick and the NACIS Board of Directors, who helped make this exhibit possible. Thanks to Dylan Moriarty and Charlie Rader for their amazing camera work. A special thanks goes out to Kryssy Pease and Tom Crann from Minnesota Public Radio, who covered the exhibit in a thoughtful radio piece that stirred interest in the local Minneapolis community and beyond.

"Please touch!" Photo by Charles P. Rader

Visual Fields focuses on the appreciation of cartographic aesthetics and design, featuring examples of inspirational, beautiful, and intriguing work. Suggestions of works that will help enhance the appreciation and understanding of the cartographic arts are welcomed, and should be directed to the new incoming section editor, Matt Dooley: mathew.dooley@uwrf.edu.

ESSENTIAL EARTH IMAGING FOR GIS



By Lawrence Fox III.

Esri Press, 2015.

128 pages, diagrams. $59.99, paperback.

ISBN: 9781589483453

Review by: Mark Denil

This is a great time for earth imaging. New sensors are being launched and are coming on line at a tremendous rate, and the variety of imagery available for use is really only limited by the depths of your pockets and the capacity of your system to consume the results. Choosing what images to obtain and how to reasonably employ them is, however, a job in itself, and it is pretty hard to make good decisions without a firm grasp of modern imaging technology basics. So, where is one to turn to learn these essentials?

To address this crying need, Esri Press has brought forth *Essential Earth Imaging for GIS* by Lawrence Fox III of Humboldt State University. It is a very slim, 128-page volume that, according to the back cover blurb, "discusses characteristics of images obtained from aircraft and spacecraft, and how to enhance, register, and visually interpret multispectral imagery and point clouds." Very ambitious, one might think, for such a small book; but it is all pulled off rather neatly and with admirable concision. There doesn't seem to be an ounce of fat anywhere in the text, nor is there any sales department boilerplate. Essential it is, indeed.

The book is made up of eight chapters plus a three-page introduction, a couple pages of references, and an index. The chapter titles are:

- Overview of imaging GIS
- The physical basis and general methods of remote sensing
- Effects of the atmosphere on image quality
- Creating two-dimensional images with sensors
- Displaying digital images with GIS software
- Generating three-dimensional data with photogrammetric measurements and active sensors
- Image processing
- Extracting information from images

Each seven to twenty page chapter contains between two and seven sub-sections.

Chapter 1 begins with a historical overview so very brief that it is over before the reader has quite noticed it has begun, and from there leaps directly into examining the structure of a digital image. We then briskly learn that there are various sorts of two-dimensional images and of three-dimensional data sets; and we are off and running.

Chapter 2 tells us about how images are formed by electromagnetic radiation sensors. Discussion touches upon the basic capabilities and limitations of the different sensing methods and how the characteristics of aerial and spaceborne platforms influence their output products: for example, how electromagnetic radiation wavelengths and reflectance patterns are important for passive sensors, how active sensors work, and why satellite orbits matter.

All earth imaging has to take place through the earth's atmosphere, and in Chapter 3 we learn about the interaction of radiation and air as it affects the quality of a remotely sensed image. Absorption, scattering, and big fluffy clouds are the main actors in this chapter.

The geometric and resolution characteristics of passive and active sensors fill two-thirds of Chapter 4. Simple geometric diagrams support texts explaining that the geometry of either sensor type is really a lot more complicated, but the explanations are hardly more than quick sketches themselves. As you read them you should keep that word, "essential," in mind. The discussion then turns to the four kinds of resolution (spatial, spectral, radiometric, and temporal), and these get a much fuller exposition.

The final third of Chapter 4 covers common sources for remote sensing imagery. It strikes one as an odd place in the book to put this; one would expect it in an appendix or at least an end chapter. As the kind of information that tends to go out of date, plunking it in the midst of the sort of basics one could expect to remain pertinent for a long time mightn't seem obvious. The location does, however, group the sensors near their characteristics.

At twenty pages, the longest chapter in the book is Chapter 5: "Displaying digital images with GIS software," and it certainly has a lot of ground to cover. The chapter opens with a pretty good discussion of additive color. The author consistently refers to it as the *tristimulus* theory, which in my experience is a rather less common descriptor than "additive" or "trichromatic." The term tristimulus (and tristimulus value) is more usually associated with the CIE color spaces, and one would guess that it is likely to be in more frequent use amongst folks building image software than people using GIS applications. Still, the author is correct and consistent in his usage and clear in his meaning, and that is what matters.

The author is also quite clear in his explanations of the various options in assigning colors to spectral bands. His detailed and well-explained discussion, for example, of natural-color, standard false-color, and false-color with IR composites, and how to use them, is excellent, as are the sections on contrast, brightness, and histogram stretching.

Chapter 6 tackles generating three-dimensional data. Starting with measurements on a single photo, it moves on to stereo pairs and to surface models and orthophotos, automated photogrammetry, and finally to lidar and interferometric radar. It's all there; readable, short, and sweet and stuffed into just fourteen pages.

Image processing, divided into restoration, rectification, and enhancement, with an emphasis on automated execution of routines with little human input is covered in Chapter 7. The topic is expanded to include converting brightness values to radiance and atmospheric correction of brightness values. Here are another fourteen pages packed as full as a nut.

Chapter 8 is titled "Extracting information from images," and covers manual image interpretation as well as the advantages and disadvantages of automated classification, plus how to evaluate automated outputs. Here, *Essential Earth Imaging for GIS* only professes to touch on the rudiments of automated classification, and, as in other places in the text, it is not shy of telling the reader they have to look to the references for anything beyond the basics supplied.

In addition to the printed text, your $60 gets you access to an online Esri Press resource page with exercises and a free 180-day ArcGIS trial. There are five exercises that come with instructions and sample data:

- Exploring brightness values of pixels in a simple image
- Assigning colors in multiband images
- Global brightness and contrast manipulation with histograms
- Color-coding a single-band image and a vegetation index image
- Extracting information from a multispectral image by digitizing polygons on screen

As already mentioned, this book sets out by promising to deliver the essential, baseline things that anyone using earth imaging products in a GIS must know. In the end, it delivers on that promise and it does so with seemingly effortless panache.

This book is, nonetheless, not without fault. The text is sprinkled with awkwardly constructed passages that are unnecessarily confusing. The individual sentences are fine, but they are in places assembled into paragraphs with odd switches of perspective. For example:

> Atmospheric scattering can also be reduced by avoiding early morning or late afternoon hours. Solar radiation must travel through a greater thickness of atmosphere when the sun is low in the sky because of the angled path. Not only is the haze effect reduced, but the intensity of the solar radiation is greater near solar noon. (27)

The first two sentences discuss low angle light, and the following one, mid day lighting. However, the reader doesn't realize that the light has changed until the end of that third sentence where the key words "near solar noon" are buried. The reader gets well into the sentence wondering why the haze is suddenly spoken of as *reduced*, and the radiation as *intensified*, with, as they assume, the sun still low in the sky. This sort of unnecessarily clunky construct crops up time and again and is cussedly annoying.

Then too, the author is given to sudden insertions of some quite startling assertions, equally unequivocal and factually questionable. "Contour lines are being replaced by three-dimensional perspective views.…" (67), is one such, but the bald statement that "…images are only a map (an orthographic projection of the Earth's surface having a constant scale) if the image is perfectly vertical and the terrain is absolutely flat" (69) is a real corker. Where can that have sprung from? First off, there is that flatly absurd definition of a map (as demonstrated by Jacob [2006] and Denil [2011]), and, second, the author (if anyone) should know that no actual photograph is orthographic (although photos can be ortho-corrected). There are other examples of quirkiness lurking between the covers, but the point needn't be belabored.

You may think that these objections are pretty minor, but they mar and diminish the smooth and placid finish on what is otherwise an admirable production.

Despite these shortcomings, *Essential Earth Imaging for GIS* is well worth having. It is not a bible of remote sensing, like Avery and Berlin's *Fundamentals of Remote Sensing and Airphoto Interpretation* (1992) was, back in the day; it is not full of formulas, detailed explanations, and stereoscope-ready image pairs, but it is a good, basic introduction to the remote sensing essentials that matter for GIS. The complexities of modern earth imaging can be bewildering, even for experienced hands, and good, basic, essential texts are hard to find. The concise explanations found within this book can help clarify critical points, both for oneself and when one is looking to explain things to others. I know I am happy to have a copy on my shelf, and, not infrequently, in my hand.

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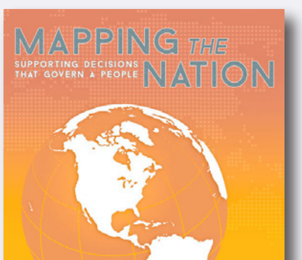
MAPPING THE NATION (SERIES)

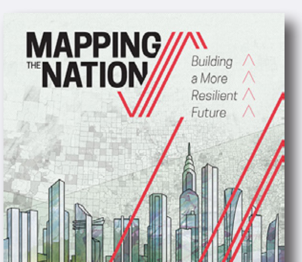


Mapping the Nation: Supporting Decisions that Govern a People

Esri Press, 2014.

144 pages, maps, credits. $19.95, softcover.

ISBN: 9781589483477



Mapping the Nation: Building a More Resilient Future.

Esri Press, 2015.

108 pages, maps, credits. $19.99, softcover.

ISBN: 9781589483910

Review by: Russell S. Kirby, University of South Florida

Since 2011, Esri Press has been publishing a series of books featuring maps generated by federal government agencies using GIS software. These books, published in large format, softcover editions, are attractively produced with high-resolution graphics. The two volumes reviewed here are respectively the fourth and fifth books in the series. Each has the same structure, beginning with a foreword by Jack Dangermond, President of Esri, Inc., and a brief introduction, then continuing through a series of chapters focusing on US government departments and a final chapter on independent government agencies, followed by a brief conclusion and some information concerning the sources of the maps included in each chapter.

For someone unfamiliar with GIS and its many potential applications, these books—printed on high-gloss paper with strikingly colorful maps, plus photographs and quotations from leading government agency officials— reveal both the wealth of spatial data managed by federal agencies and creative ways to display that information and, in some cases, enable the public to examine it interactively. And, perhaps, the inquisitive reader may also take the time to learn more about Esri, Inc., the producer both of this series of books and of ArcGIS, the software used to create most of the maps included within their covers.

For someone familiar both with GIS and with available public-use spatial data sources, the books may still hold some interest, as they contain many maps examining issues of current political, health, or ecological concerns. A few examples from each book may serve to illustrate this point. As part of a chapter on Department of Defense map, page 53 of *Mapping the Nation: Supporting Decisions that Govern a People* features a US Army Corps of Engineers map comparing the extent of the historic 1927 flooding in the lower Mississippi River valley with the more recent spring 2011 flood. The striking differences reveal the effectiveness of an extensive network of levees along the riverbanks as well as numerous dams on tributaries upstream that created a series of what my introductory geology professor called "Democratic Lakes." Both floods covered large swaths of the lower Mississippi River basin, but the 1927 flood caused vastly greater damage and loss of life.

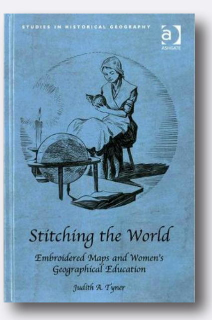
In the same volume, readers familiar with mapping remotely sensed data may find interesting the maps from the National Agricultural Statistics Service of the US Department of Agriculture depicting the USDA NASS Cropland Data Layer (26–27). Some minor details, such as a legend, are omitted, both in the composite map and in two separate strata, but the interested reader who wishes to explore more is given the resources to do so.

Another interesting example, found in *Mapping the Nation: Building a More Resilient Future,* is a map from the National Center for Education Statistics of the US Department of Education that displays the proportion of school-age children living in households with incomes below the federal poverty rate (46). This map shows one year from a series of annual maps beginning in 2005; on the agency website the enterprising reader can see the full series. The maps, depicting poverty within state by school district, show both the complexities in the national geography of school districts, and some idiosyncrasies in the national school district shapefiles, especially in the Great Lakes region. These maps can also be compared to one provided by the US Census Bureau (19), depicting the poverty ratio for essentially the same age group of children as a smoothed surface rather than as choropleth maps.

For readers with smartphones, most of the maps in each volume are accompanied by QR codes that can be scanned to access websites with additional information about the maps and the underlying data sources. For the slightly less technology-savvy reader, most maps also include URLs that can be entered to access the same resources.

These books fulfill a purpose for Esri: opening the eyes of those unfamiliar with the potential power of GIS to generate interesting maps that produce both insights and new lines of inquiry. To some extent the contents may also inspire a few readers to examine the underlying spatial data more closely, or even to seek employment at one of the many federal agencies whose work is highlighted. However, these volumes are clearly prepared for marketing purposes. While Esri may make them available at professional conferences and to others who might share them with students, trainees and young professionals, this reviewer would not recommend that libraries or GIS professionals purchase these volumes, even at the relatively reasonable cover price.

STITCHING THE WORLD: EMBROIDERED MAPS AND WOMEN'S GEOGRAPHICAL EDUCATION



By Judith A. Tyner.

Ashgate, 2015.

142 pages, numerous black and white illustrations, 46 color plates. $104.95, hardcover.

ISBN: 9781409426356

Review by: Karen M. Trifonoff, Professor Emerita, Bloomsburg University of Pennsylvania

Through the centuries cartographers and others have created maps on and with a variety of different media, from sticks and stones, animal skins, paper of all kinds, through to the digital maps of our current world. Within this variety is a small but important subset of maps on fabric, stitched with threads of many colors. These maps, created by young girls and women in the eighteenth and nineteenth centuries, are an important but not widely known segment of cartographic history. In *Stitching the World: Embroidered Maps and Women's Geographical Education*, Judith A. Tyner gives us a glimpse into the story of how and why these maps came to be. This volume is the result of over 20 years of research in museum archives, textile collections, and historical societies across the United States and the British Isles. In many instances, seeking to find the elusive map sampler involved a bit of detective work in order to connect a specific artifact to the person who created it, and to determine where and why it was created. Through her superior research skills, Tyner has woven together a volume that combines information on cartography, geography education, and needlework in order to tell the important story of map samplers.

The book is organized into six chapters, and contains figures and tables, 46 color plates, four appendices, and a bibliography. The goal of the book is to shed light on the history of women's geographic education by examining the relationship between needlework, education, geography, and cartography. The numerous illustrations and plates provide examples from the eighteenth and nineteenth centuries that are used to support the author's viewpoint.

The audience for this book may include people not versed in cartographic terminology, or conversely, those not familiar with the needlework sampler examples. The two introductory chapters are critical in terms of bringing all readers up to speed on the requisite terminology. In the eighteenth and nineteenth centuries young girls would work, or embroider, the alphabet and a phrase or maxim on a piece of woven cloth (typically) with silk thread (usually) in order to learn the rudiments of the alphabet and grammar, and to practice and improve their needlework skills. Within the universe of these samplers there is a unique subset of "working maps" or map samplers. Color Plate 1 provides an example of a map sampler made in the 1770s (Figure 1). The counties of England were worked in silk thread on fabric by 13-year-old Ann Rhodes for her school geography project. The sampler includes place names, marks for latitude and longitude, a compass rose, and a variety of ships. Thus, a project that typically would result in a paper product is instead rendered in a new medium, enhancing both the geographic and needlework accomplishments of the young woman.

Figure 1.

Three other key parts of the early chapters include clarifying the definition for the word "map," providing background on the time period of the study, and providing a cartographic framework for the study. While the work of defining "map" is a rehashing for most cartographers, it is an important consideration for those not versed in cartography, whose definition of what constitutes a map is often quite narrow. Also, having a background in the events of the study period is critical for explaining why map samplers occur when and where they do. The eighteenth century "Enlightenment" viewpoint recognized the importance of geography and travel in order to develop an expansive worldview. Maps and globes were seen as special objects that were essential in developing this new worldview, and were looked on with great reverence. And then the Industrial Revolution came along at just the right time to provide new materials, tools, techniques, and methods for generating these necessary maps. Along with this technological growth was the growth of the middle class, who had an interest and the means to educate their children, both boys and girls. While boys were learning Latin and Greek, girls were making samplers and embroidered maps to improve their needlework skills and expand their geographic knowledge. Tyner uses David Woodward's framework for the study of historic maps and creates a similar framework for the study of historic map samplers. Woodward's framework considers production and product across the categories of information gathering and processing, and document distribution and use. Paper maps were made by draftsmen, engravers, and printers, and resulted in a map image that was marketed and published

Figure 2.

for a specific audience. Tyner's table draws important parallels to the study of map samplers. Map samplers were made by teachers and students and resulted in map images for study, decoration, and to exhibit the accomplishments of the maker. By providing the reader with a context for the inclusion of map samplers within cartographic history, the author sets the stage for the rest of the book.

The discussion of specific map samplers begins in Chapter Three with a look at examples from the British Isles. One of the goals of this volume is to establish the provenance for these cartographic treasures, and Tyner's careful examination of map outlines, place names, projections, map elements, and decorative elements has resulted in the identification of several map sampler regions and schools. While there were many options for the education of young women in the British Isles—home schooling, dame schools, and boarding schools—most of the map sampler examples have been linked to specific boarding schools or female academies. Some of the more enduring schools were those founded by Quakers, and specific map samplers have been traced to these schools in Yorkshire, England, and Mount Rath, Ireland. While Quaker schools strived for simplicity and discouraged unnecessary ornamentation in their alphabet samplers, map samplers were allowed to be more ornate as their practical use as study aids gave them dispensation from the simplicity rule. Many of the Quaker map samplers can be linked to a specific location or school through the identification of their floral borders and elaborate cartouches. Identifying the source map or pattern used for these samplers can be problematic, as paper patterns are often destroyed in the transfer process. Through another bit of investigative work, Tyner has uncovered evidence that suggests that there were professional pattern makers, and has found an example of a specific printed pattern, that was most likely used in three map samplers. These samplers from Miss Warren's Ladies' Boarding School in Truro have identical base maps of Cornwall, and differ only in their decorative map elements.

Several schools and teachers in the United States have also been identified as "hot beds" of map sampler activity. Susan Rowson is considered one of America's first geographers, and her Academy in Boston was started around 1800. While Rowson's Young Ladies Academy was not known for map samplers, there are two nearly identical large-scale embroidered maps of Boston Harbor attributed to the school. They were likely made using a map from *American Monthly Museum*, published in 1775, and are fine examples of large-scale maps worked in thread. One of the largest groups of map samplers are a set of 10 of Maryland; this set provides a good example of the types of map samplers made in America. While some of the young women mapmakers have been identified, the specific teachers and schools remain unknown. But since these examples are found all over the state, it is possible to identify a common source. The source map is believed to be Samuel Lewis' map of Maryland from 1785 that was in Mathew Carey's *Atlas to Accompany Guthrie's Geography* (Figure 2). The spelling of place names, shape of islands in Chesapeake Bay, and longitude designations on the samplers all point to this as the source map that was either traced on cloth, or printed as a pattern. The deciding factor in confirming this map as the source is the omission of the western portion of the state, which was included as an inset on Lewis' map. Every map sampler omits this inset; perhaps design and balance were more important than geography. S. Falconar's *Map of Maryland* is a typical example,

Figure 3.

with the longitude from London at the bottom, and from Philadelphia at the top, as per the Lewis map (Figure 3).

The most unique cartographic needlework creations of all are the silk globes created at the Westtown Quaker Boarding School, about 30 miles west of Philadelphia, from 1804–1844. Since there are samplers from the Westtown School, but no map samplers, it is puzzling as to why and how the globes appear. Tyner posits that the globes may have been made to teach what was called "mathematical geography," or latitude, longitude, and Earth-Sun movements. This idea is supported by a quote from a letter of Rachel Cope, written to her parents in 1816:

> I expect to have a good deal of trouble in making [the globes], yet I hope they will recompense me for all my trouble, for they will certainly be a curiosity to you and of considerable use in instructing my brothers and sisters, and to strengthen my own memory, respecting the supposed shape of our earth, and the manner in which it moves… (89)

These globes, both terrestrial and celestial, were made on a silk foundation in gores or wedges, and have the continental outlines, parallels and meridians embroidered, and place names and other features inked. A canvas ball was stuffed with wool, and the gores sewn together and the cloth ball inserted before the final seam was sewn (Figure 4).

This volume is a work of scholarship that makes an important contribution to both cartographic and needlework history. The extensive bibliography and inclusion of numerous primary sources has great value for future researchers. The appendices with lists of museums and historical societies housing map samplers are also important,

Figure 4.

as is the list of map samplers and embroidered globes that form the database for this volume. And the publisher is to be commended for including the excellent color plates that make this book such a valuable resource. Of particular note are plates not previously mentioned in this review, which show several versions of a two-hemisphere (globular) world map having the same or similar map figure with different border treatments. Also of interest is a rare large-scale embroidered map of an individual farm in Essex, England.

This volume has much to recommend it. First, it legitimizes the place of map samplers as an important part of history of cartography. Second, it gives recognition to the contributions of young women to the history of cartography. Third, the book is structured to have a wide appeal, so as non-cartographers pick up this volume, a new audience will be introduced to the fascinating discipline of cartography. And finally, I think it will encourage others—myself included—to search for embroidered maps in their local communities, and will ultimately make it possible to find many more embroidered map masterpieces in museums and historical societies and attics.

Cartographic Perspectives (*CP*) publishes original articles demonstrating creative and rigorous research in cartography and geographic visualization under open-source licensing. Papers undergo double-blind peer review; those accepted for publication must meet the highest standards of scholarship, address important research problems and issues, and appeal to a diverse audience.

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Robinson, A. H., J. L. Morrison, P. C. Muehrcke, A. J. Kimerling, and S. C. Guptill. 1995. *Elements of Cartography, 6th Edition.* New York: John Wiley & Sons.

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